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MONTEREY, CALIFORNIA

THESIS

**AN ANALYSIS OF THE EFFECT OF COMMISSIONING
SOURCE ON THE RETENTION AND PROMOTION OF
U.S. AIR FORCE OFFICERS**

by

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March 2010

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RETENTION AND PROMOTION OF U.S. AIR FORCE OFFICERS**

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ABSTRACT

This thesis investigates the effect of commissioning program on career progression for U.S. Air Force Line officers. This study specifies and estimates three logistic regression models to analyze the relationship between commissioning source and officer performance using retention and promotion to O-4 as performance measures. Two measures of retention were used: the retention after expiration of the initial minimum service requirement, and retention to the O-4 promotion board. The data used in the models was provided by Defense Manpower Data Center (DMDC) and contained information about demographics, professional and educational background, and reasons and dates for separation for officers who were commissioned between 1992 and 2006.

The analysis of all three logistic regression models finds out that commissioning source is a significant determinant of retention and promotion in the Air Force. Commissioning through the United States Air Force Academy (USAFA) increases the probability of staying in the Air Force. Although USAFA graduates were initially expected to have higher promotion rates, the results suggest that they are less likely to promote to the grade of O-4 than officers commissioned through OTS and the ROTC Non-Scholarship program. However, USAFA graduates have a higher probability of promotion than officers from the ROTC scholarship program.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACT	American College Testing
ADMMF	Active Duty Military Master File
AECP	Airman Education and Commissioning Program
AFB	Air Force Base
AFOQT	Air Force Officer Qualifying Test
AFROTC	The Air Force Reserve Officer Training Corps
AFSC	Air Force Specialty Code
ANOVA	Analysis of Variance
ASCP	Airman Scholarship and Commissioning Program
BOT	Basic Officer Training
CFA	Candidate Fitness Assessment
COT	Commissioned Officer Training
DMDC	Defense Manpower Data Center
DNP	Do Not Promote This Board
DoD	Department of Defense
DP	Definitely Promote
HBCU	Historically Black Colleges and Universities
HIS	Hispanic-Serving Institutions
ICSP	In-College Scholarship Program
GMC	General Military Course
LAF	Line of the Air Force
LM	Logit Model
LPM	Linear Probability Model
MECEP	Marine Corps Enlisted Commissioning Program
MSR	Minimum Service Requirement
OCS	Officer Candidates School
OLS	Ordinary Least Squares
OTS	Officer Training School
P	Promote
POC	Professional Officer Course

POC-ERP	Professional Officer Course-Early Release Program
RL	Restricted Line
ROTC	Reserve Officer Training Corps
SAT	Scholastic Assessment Test
SF	Separation File
SOAR	Scholarships for Outstanding Airman
TBS	The Basic School
URL	Unrestricted Line
USAFA	The United States Air Force Academy
USNA	United States Naval Academy
YCS	Years of Commissioning Service

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I. INTRODUCTION

A. BACKGROUND

The mission of the United States Air Force is to “fly, fight and win...in air, space and cyberspace” (The United States Air Force Web site, 2009). The most important asset of the U.S. Air Force is its people who allow it to accomplish its mission. The U.S. Air Force consists of active duty officers, enlisted personnel and civilian employees. There are (as of October 5, 2009) 328,847 individuals on active duty in the Air Force, of which 65,496 are officers and 263,351 enlisted personnel (Air Force Demographics, 2009).

Commissioned officers are the leaders of the Air Force. They hold positions of authority and have the important responsibility of training their subordinates. Their performance is crucial for the success of the air Force squadrons and units. Therefore, it is a priority for the Department of Defense (DoD) and the U.S. Air Force to attract and retain the highest quality officers.

There are five main commissioning sources for Air Force officers:

- The United States Air Force Academy (USAFA)
- Reserve Officer Training Corps (ROTC)
- Officer Training School (OTS)
- Direct Appointment
- Enlisted-to-Officer Programs.

Currently, 19.15 percent of the U.S. Air Force officers are commissioned through USAFA, 42.8 percent through ROTC, 19 percent through OTS and 17.2 percent are commissioned through other sources (direct appointment, etc.) (Air Force Demographics, 2009).

Commissioning sources have different features and costs. USAFA provides the longest military training and probably has the highest cost of all sources. ROTC programs do not provide the same amount of military acculturation, but are less costly. OTS provides even less military training but provides a quick response program to meet any

unexpected surge in officer requirements caused by rapid policy changes that affect the current structure of the Air Force. OTS enables the Air Force to have commissioned officers in relatively less time and at a lower cost. Direct Appointments have the least military experience before commissioning, but the Direct Appointment program enables the Air Force to attract and employ individuals with specific specialties that could not be commissioned through other sources. The least expensive and most reasonable way of commissioning a medical officer, for example, is likely via the direct appointment program.

Since the costs and quality of officer commissioning programs are important to the DoD, it is reasonable to investigate whether there is any relationship between officer performance and commissioning source, in order to determine the optimal accession mix. Although previous studies have analyzed the effect of commissioning sources on performance of officers in the other military services, there is no study that specifically analyzes the effect of commissioning sources on performance of Air Force officers.

Most of the prior studies have used retention and promotion indicators as measures of officer performance. Studies used multivariate regression models to analyze the effects of commissioning program and other variables such as demographics, professional and educational traits on the selected performance measures.

Previous studies have produced varying results. In his study, Turgay Demirel (2002) analyzed officer retention in the U.S. Military. He estimated logistic regression models and found significant differences in retention among graduates of the Service Academies, ROTC Scholarship and ROTC Non-scholarship Programs, Officer Candidate/Training Schools, and Direct Appointment Programs. Joel P. Bernard (2002) analyzed the effect of commissioning sources on the retention and promotion outcomes of navy officers to the O-4 promotion point. He found that U.S. Naval Academy (USNA) graduates are less likely to stay, but are more likely to be promoted than officers from the other commissioning sources. He also performed a cost-effectiveness analysis of the alternate accession sources and found that the USNA is the most cost-effective commissioning program for meeting future accession increases. Zafer Kizilkaya (2004) analyzed the effect of commissioning sources on retention and promotion of U.S. Army

Officers. He concluded that U.S. Military Academy (i.e., West Point) graduates have the lowest retention rates and OCS graduates have the highest retention rates. He finds that military Academy graduates are more likely to be promoted to Lieutenant Colonel than those from other sources. Major Levent Ergun (2003) examined officer accession programs and the career development of U.S. Marine Corps officers. The study consisted of evaluation of fitness reports, performance at The Basic School (TBS), retention, and promotion to the O-4 and O-5 ranks. According to the results of the study, USNA graduates have better fitness reports at all grades between O-1 and O-4 but have lower O-4 promotion rates than officers from the other commissioning programs. The retention rate of the USNA graduates to 10 years of commissioning service (YCS) is lower than the Marine Corps Enlisted Commissioning Program (MECEP) but higher than the other commissioning program.

B. PURPOSE OF THE STUDY

The objective of this study is to determine if there is a statistical relationship between commissioning source and career performance of Air Force Line officers. The thesis uses retention and promotion as a measure of performance.

This thesis examines the effect of commissioning source on retention at the minimum service requirement (MSR) point, retention to the O-4 promotion board and promotion to the grade of O-4. The analysis of the determinants of retention should enable decision makers to retain high quality officers from among the various commissioning programs.

C. RESEARCH QUESTIONS

- Does commissioning source have any effect on retention at the end of initial obligated service and to the O-4 promotion board?
- Is there a difference in the rate of promotion to the grade of O-4 among officers from the different commissioning sources?

D. SCOPE, LIMITATIONS AND ASSUMPTIONS

The thesis includes an overview of officer commissioning sources and the promotion system in the U.S. Air Force. Officers who stay beyond their initial obligated service and those who stay long enough to promote to the grade of O-4 will be the focus of this study. The study will construct three models: one for retention after minimum service requirement (MSR), one for retention to the grade of O-4 and one for promotion to the grade of O-4. The original data set used in the analysis was taken from the Defense Manpower Data Center (DMDC) and includes Air Force Line officers commissioned between 1992 and 2006. Officers who had been separated from the Air Force involuntarily are not included in the study. The scope of the study includes an analysis of retention and promotion decisions, an interpretation of the statistical results and recommendations for decision makers.

The thesis does not include a cost-effectiveness analysis to estimate marginal cost of commissioning an officer from each source nor does it control for the other performance measures such as fitness reports and evaluation reports as they are not available in the data set. Therefore, findings may not be sufficient to determine the optimal mix of officer accessions from the various commissioning sources. However, this research does provide policy makers with useful information about the retention and promotion tendencies of Air Force officers.

The research assumes a significant relationship between commissioning sources and officer performance. Differences in partial effects of commissioning sources on performance are also expected. Since USAFA provides longer military training and acculturation, the academy graduates are expected to stay longer.

E. OUTLINE OF THE STUDY

This thesis includes five chapters. Chapter II provides relevant literature information about the concern of the study. This section includes useful information about commissioning sources, officer classification structure and career development, and the promotion system of the Air Force. It also reviews relevant past studies. Chapter

III introduces the data and presents preliminary analysis of the variables. Methodology of the study is also discussed in this part. Chapter IV includes the results of the multivariate analysis of retention and promotion models. Chapter V summarizes the study. In this section, significance of the results are discussed and compared with results of prior studies. This chapter also addresses conclusions and includes recommendations for further research.

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II. BACKGROUND AND LITERATURE REVIEW

This chapter consists of five sections. The first section provides information about the commissioning of U.S. Air Force officers and includes a description of the primary Air Force officer commissioning sources. The second section discusses officer classification structure and career development in the U.S. Air Force. The third section addresses the promotion system for Air Force officers. Relevant prior studies are analyzed in the fourth section. Section four also provides information about the data sets and methodology used in the relevant previous studies and also includes the results of those studies. The last section summarizes the chapter.

A. COMMISSIONING PROGRAMS FOR U.S. AIR FORCE OFFICERS

It is the soldier who enables America to meet its leadership responsibilities worldwide. Soldiers are our investment in America. Soldiers in our formations, from all components, are deploying overseas and showing America how real that investment is...

Some of the finest leaders in our country, military and civilian, public sector and private, learned what they know about leadership in our ranks... (Shinseki, 2000)

Commissioned officers are the leaders of the enlisted personnel force. They are the decision makers of the Armed Forces. Officers train their subordinates and command military units. They often seem to be the representatives of the armed forces. Since officer quality and performance directly affect the success of their military units, their recruitment and retention is crucial for the Air Force.

As noted in Chapter I, there are five main commissioning sources for U.S. Air Force officers:

- The United States Air Force Academy (USAFA)
- Reserve Officer Training Corps (ROTC)
- Officer Training School (OTS)
- Direct Appointment

- Enlisted-To-Officer Programs

Each source has different features. USAFA has the longest military education and training, 4 years, whereas OTS has only a 12-week commissioning program (OTS Fact Sheet, 2009). USAFA provides the best military acculturation. ROTC programs do not provide the same amount of military education and training, but they are less costly than USAFA. Commissioning through OTS makes it possible for the DoD to commission officers in a relatively short period to meet unexpected fluctuations in officer demand. Direct Appointment is a cost-effective way of commissioning officers with special career branches such as judge advocates, chaplains and health professionals. Enlisted-to-Officer programs increase job satisfaction and motivation of the enlisted force by allowing them the option of becoming officers. These programs are useful to encourage high quality enlisted members who might otherwise seek civilian career opportunities to stay in the military, thus avoiding the loss of experienced personnel.

Table 1 shows the current distribution of the officer corps by the main Air Force commissioning sources:

<i>Accession Source</i>	<i>Percentage</i>
USAFA	19.15 %
ROTC	42.80 %
OTS	19.00 %
Other sources (direct appointment, etc.)	17.20 %

Table 1. Source of commissioning of U.S. Air Force officers (Source: Air Force Demographics, 2009)

1. The United States Air Force Academy (USAFA)

The mission of the U.S. Air Force Academy is to train, educate, and inspire men and women to become officers of character motivated to lead the United States Air Force (U.S Air Force Academy 2008–2009 Catalog, 2009). The USAFA is located just north of Colorado Springs, Colorado, on an 18,000-acre campus. The United States Air Force

Academy is a 4-year program. This program consists of professional military and academic education to provide cadets the knowledge and character essential for leadership, and the motivation to serve as career Air Force officers.

Academy graduates receive a Bachelor of Science degree and a commission as a second lieutenant in the Air Force. Almost 60 percent of the graduates may follow flight careers such as fighter pilot, bomber pilot, airlift pilot, helicopter pilot, special operations pilot, air battle manager, and astronaut. Other non-flying career opportunities are presented below in Table 2 (U.S Air Force Academy 2008–2009 Catalog, 2009).

<i>Category/Specialty</i>		<i>% of Non-Flying officers in each specialty</i>	
Operations	Air Traffic Controller	1 %	11 %
	Air Battle Manager	1 %	
	Combat System Operator	1 %	
	Space and Missile Operations	8 %	
Scientific/Technical	Weather	1 %	45 %
	Scientific	6 %	
	Civil Engineering	7 %	
	Development Engineering	11 %	
	Acquisition Management	7 %	
	Communications/Computers	13 %	
Sortie Generation/Logistics	Missile Maintenance	1 %	14 %
	Aircraft Maintenance	4 %	
	Logistics Plans/Programs	3 %	
	Intelligence	6 %	
Mission Support	Contracting	7 %	30 %
	Financial	3 %	
	Manpower/Personnel	3 %	
	Security Police	2 %	
	Services	1 %	
	Information Management	4 %	

<i>Category/Specialty</i>		<i>% of Non-Flying officers in each specialty</i>	
Mission Support	Public Affairs	1 %	30 %
	Special Investigations	1 %	
	Health Services Administration	5 %	
	Biomedical Services	1 %	
	Other	2 %	

Table 2. Distribution of Non-flying Categories among USAFA Graduates. (From: U.S Air Force Academy 2008–2009 Catalog, 2009)

a. Eligibility

USAFA's cadet strength is set at 4,000 by current directives. One must have the following features to be eligible for appointment consideration:

- Must be at least 17, but less than 23 years of age by July 1 of the year that he/she enters the Academy
- Must have U.S. citizenship
- Must be of high moral character
- Must meet high leadership, academic, physical and medical standards
- Must be unmarried, with no dependents

A student who wants to attend the Academy must have a high school or above academic degree. Students should take American College Testing (ACT) or Scholastic Assessment Test (SAT) tests and send results to the Academy. Test scores must be on record before an individual can be accepted for an appointment. To examine the physical condition of an applicant, the Candidate Fitness Assessment (CFA) is given during the admissions process. Lower scores of academic and physical tests are less competitive.

The laws require applicants to have a nomination to attend the Academy. Congressional category is the primary nomination source for most candidates. Each Member of Congress can nominate five applicants; thus, 100 U.S. Senators and 475 U.S.

Representatives can make 2675 appointments. Almost 30 percent of the cumulative appointments enter the Academy every year. Figure 1 shows the nomination categories and authorized appointments.

Nomination	Appointments Authorized (Cumulative)
100 United States Senators (5 each)	500
435 United States Representatives (5 each).....	2,175
Vice President	5
District of Columbia	5
Puerto Rico	6
American Samoa	3
Guam	3
Virgin Islands	3
Commonwealth of the Northern Mariana Islands	1
Children of Deceased or Disabled Veterans or Children of Persons in a Missing Status.....	65
International Students (Maximum allowed annually by law)	60
Presidential	100
Regular Components	85
Reserve Components	85
Honor Military and Naval Schools, AFROTC and AFJROTC.....	20
Children of Medal of Honor Recipients	No Limit
Qualified Alternates	Number needed to fill each class

Figure 1. Nomination Categories (From: U.S Air Force Academy 2008–2009 Catalog, 2009)

The evaluation process of the applicants is based on three components and almost 20 percent of the applicants are accepted to the Academy (USAFA Admissions Facts, 2009). Table 3 discusses the evaluation criteria and the weight attached to each criterion.

<i>Name of the Criterion</i>	<i>Explanation</i>	<i>Percentage Weight</i>
Academic Composite	High School or College academic performance, SAT or ACT scores	60%
Extracurricular Composite	Athletic participation, leadership position (scouts, school clubs, class officer, etc.), public/community involvement and work experiences	20%
Admissions Panel	Faculty and staff review, candidate fitness test, Admissions Liaison Officer interview, and writing sample	20%

Table 3. USAFA Evaluation Process of Candidates (After: U.S Air Force Academy 2008–2009 Catalog, 2009).

b. Service Obligation

USAFA offers a fully-funded instruction for its cadets. Education cost per year is \$42,000 and the total cost per USAFA graduate is almost \$403,000 (USAFA Admissions Facts, 2009). Additionally, Cadets receive \$864 monthly pay for their various expenses, such as the cost of uniforms, books and supplies and personal spending (USAFA Admissions Facts, 2009). Since a lot of money and other resources are invested in cadets to train and commission them as officers, there is obligated service after graduation from the Academy.

All cadets except international students have to sign an agreement before taking the Oath of Allegiance stating that they will fulfill the following service obligations:

- Complete the instruction period at the Academy (unless they are dismissed by proper authority)
- Serve as a commissioned officer in the Air Force for at least eight years after graduation.

Most USAFA graduates incur a 5-year active duty service commitment. The remaining 3 years may be served as inactive reserve. Commissioned officers may request to leave the Air Force after the initial 5-year active duty service. However, some of the graduates who enter pilot, navigator or other special training for a specific career branch incur a longer commitment after they complete their training. For example, the active duty service commitment is 10 years for pilots (the Air Force policy in effect when one enters flight training determines the length of the commitment), 6 years for navigators and Air Battle Management career field officers (Benton, 2005).

c. Summary

The Academy commissions approximately one fifth of new Air Force officers. It provides cadets with the longest duration of professional military training in addition to a substantial academic program to train them as officers with essential occupational and leadership skills to serve in the Air Force. USAFA is likely the most expensive source of commissioning, averaging \$403,000 per graduate. However, the

marginal cost per Air Force Academy graduate may be lower relative to the other commissioning sources, since many of the costs are fixed.

2. The Air Force Reserve Officer Training Corps (AFROTC)

The mission of the AFROTC is to develop quality leaders for the Air Force. AFROTC is a college program that prepares individuals to become Air Force officers. This program is offered at more than 1000 colleges and universities across the U.S. and its graduates constitute more than 40 percent of the current Air Force officer corps (Mission & Values, 2009). According to military population representation data, in 2007 approximately half of new active component officers were commissioned via the AFROTC program (Population Representation in Military Services, 2009). Currently, AFROTC commissions more officer candidates than any other commissioning source.

Congress authorized ROTC on college campuses in 1916 with the passage of the National Defense Act. In 1952, Air University, which is located at Maxwell AFB, Montgomery, Alabama, assumed responsibility for Air Force ROTC. In 1997, after the creation of Air Force Officer Accession and Training Schools, Air Force ROTC and OTS were realigned under one organization. Today, Air Force ROTC's headquarters is at Maxwell Air Force Base, Montgomery, Alabama (History of the AFROTC, 2009).

Currently, there are 144 AFROTC units on U.S. colleges and university campuses that recruit, train and commission officer candidates. However, these AFROTC detachments have 1,025 cross-town arrangements with other institutions enabling non-host institutions' students to attend the AFROTC program (Mission & Values, 2009).

The detachments organize cadets into wings, groups, squadrons, and flights similar to the active-duty wing structure. The AFROTC program is divided into two sections: Academic Classroom Program and Cadet Activities (Leadership Laboratory, Physical Training, and other training) (AFROTC Instruction 36-217, 2004).

Students can follow the 4-year or the 2-year route to be commissioned as an officer through the AFROTC program. In addition to the normal college coursework,

students take the AFROTC classes taught by military faculty. Students have to wear uniforms during the AFROTC classes. For the other classes that are related to the college major, there is no uniform requirement.

The 4-year program includes the General Military Course (GMC) and the Professional Officer Course (POC). The GMC is the first 2 years of the 4-year program and prepares cadets for entry into the POC. This course includes 1 hour of classroom work and two hours of leadership laboratory each week. Cadets who successfully complete the GMC and wish to attend POC have to fulfill POC selection requirements. Selection criteria are based on qualitative factors such as grade point average, aptitude test scores, physical fitness test scores and unit commander's evaluation. Cadets are required to complete a 4-week summer field training program at an assigned Air Force base before entering the POC. The POC is the last 2 years of the program and prepares cadets for active duty as Air Force officers. This course consists of 3 hours of classroom work per week and 2 hours of leadership laboratory each week. Students who are enrolled in the POC are enlisted in the Air Force Reserve and assigned to the Obligated Reserve Section.

The 2-year program and the last 2 years of the 4-year program (POC) are identical. The only difference between these programs is the entry procedures. Applicants who want to apply for the 2-year program have to complete the 5-week extended field training program to prepare them for entry into the POC whereas cadets of the 4-year program are required to complete the 4-week standard field training program after the completion of GMC for entry into the POC. After successfully completing the extended field training program, cadets become committed to the Air Force when they return to school and decide to enlist through AFROTC (AFROTC Fact Sheet, 2006).

a. Requirements

The AFROTC program requirements can be divided into two sections: GMC and POC requirements. Students who want to attend GMC have to fulfill the following requirements (General Requirements, 2009):

- Must enroll in an accredited college that hosts or has a cross-town agreement with an AFROTC detachment
- Must be a United States citizen
- Must be in good physical condition
- Must be of good moral character
- Must be 14 years or older (17 years to have a scholarship)
- Must take both Aerospace Studies class and Leadership Lab each semester

Cadets who complete GMC and wish to attend POC must meet the following requirements (General Requirements, 2009):

- Must meet all the GMC membership requirements
- Must be of legal age as required by the state in which student will be attending ROTC or 17 years old with parent or guardian consent
- Must be in good academic standing
- Must have 2 academic years remaining in a degree program (undergraduate or graduate)
- Must be physically qualified (meet Air Force height and weight standards and pass the Air Force Physical Fitness Test)
- Must pass the Air Force Officer Qualifying Test (AFOQT)
- Must be selected by a board of Air Force officers
- Must complete a Field Training course

b. Scholarships

AFROTC scholarships can be categorized as High School, In-College and Enlisted Scholarships. The High School Scholarship Program offers 3-year or 4-year scholarships to high school seniors. The scholarships are classified into the following types:

- Type 1 covers full tuition, most required fees and \$900 per year for books. Almost 5 percent of the students who win 4-year scholarship will be offered a Type-1 scholarship.
- Type 2 covers college tuition and most fees up to \$18,000 and \$900 per year for books. Almost 20 percent of the students who win 4-year scholarship will be offered a Type-2 scholarship. If the tuition exceeds \$18,000 per year, then student pays the difference. All of the 3-year scholarships are Type 2.

- Type 7 covers college tuition up to the equivalent of the in-state rate and \$900 per year for books. A student can convert the 4-year Type-7 scholarship to a 3-year Type-2 scholarship.

The In-College scholarships available are the following:

- In-College Scholarship Program (ICSP) is for college freshmen and sophomores in any major. The program offers Type 2, Type 3 (tuition capped at \$9000 per year) or Type 6 (tuition capped at \$3,000 per year) scholarships for 2 or 3 years.
- Express Scholarship (Type 1) is for college students who study in specific fields such as computer, electrical or environmental engineering and foreign language majors.
- Minority School Scholarships are offered for students at Historically Black Colleges and Universities (HBCUs) or Hispanic Serving Institutions (HSIs). However, it is not required that the applicant to be a minority to apply for these scholarships. All students attending minority institutions that offer AFROTC are qualified.

The Enlisted Scholarships are as follows:

- Airman Scholarship and Commissioning Program (ASCP) allows enlisted personnel to pursue their commission through the Air Force ROTC. They separate from active duty and receive a scholarship worth up to \$18,000 per year.
- Professional Officer Course-Early Release Program (POC-ERP) allows qualified enlisted personnel to separate from active duty, sign a contract with AFROTC and become full-time college students. They receive \$900 per year for books, and a monthly nontaxable stipend of \$250–\$500.

In order to earn and maintain scholarship benefits, students must meet specific academic, military, and physical fitness standards. Also, applicants must be under age 31 on December 31 of the commissioning year to receive a scholarship (Scholarships, 2009).

c. Service Obligation

Cadets who are on contract (Professional Officer Course and scholarship cadets) have a service commitment with the Air Force. After successfully completing all requirements, the contracted cadets are commissioned as Air Force officers. The service commitment differs according to the specialty code of the cadet. However, most cadets

incur a 4-year active-duty commitment. Service obligations for some of the career branches are as follows (Service Commitment, 2009):

- The minimum service obligation for pilots is 10 years.
- Combat Systems and Air Battle Management officers incur a 6-year active-duty commitment.

d. Summary

The Air Force ROTC offers 4-year or 2-year programs and 2–4-year scholarships to eligible high school seniors, college students and enlisted military members. Scholarships help cadets with tuition, books and other expenses. After successfully completing all AFROTC and academic degree requirements, contracted cadets earn a commission in the Air Force. Professional Officer Course and scholarship cadets incur service commitment that varies due to the cadets' specialty codes. However, the minimum service obligation for most of the cadets is 4 years. AFROTC programs are less expensive but do not provide as much military training as the Academy. Since the AFROTC program commissions almost half of the Air Force officers, it is a vital commissioning source for the Air Force.

3. Officer Training School (OTS)

The United States Air Force Officer Training School is located at Maxwell Air Force Base, Montgomery, Alabama. It is a part of the Jeanne M. Holm Officer Accession and Citizen Development Center and conducts officer training under the roof of Air University. OTS's mission is to produce world-class officers of high character who possess the American warrior ethos, ready to lead Airmen and embody the Air Force's core values (Air Force Instruction 36–2013, 2008).

OTS is the successor of Officer Candidates School (OCS) that was established in 1942 with the purpose of commissioning eligible enlisted personnel as officers. OCS started to train and commission officers directly from eligible civilian individuals in 1951 and gave its last graduation in 1963. OTS was established in 1959 at Medina Annex, Texas and moved to its current location in 1993.

Unlike the other commissioning sources, OTS has the ability to quickly increase or decrease the output of officers to meet changing Air Force requirements. For example, the total number of commissioned and trained officers varied from 323 the 1st year to 7,894 officers in 1967, during the Vietnam War. Currently, the average number of officers who receive commissioning or military training via OTS is 1800 annually (OTS Fact Sheet, 2009).

a. Eligibility

Selection for OTS is based on the applicant's desires, educational background, aeronautical ratings and Air Force manpower needs. The selection board that evaluates applicants' eligibility to be Air Force officers consists of senior Air Force officers. In order to attend OTS an applicant is required (Application to OTS, 2009):

- To be a college or university graduate or senior who is available to depart for training within 365 days
- To be a U.S. citizen
- To be at least 18, but less than 34 years of age at the time of commissioning (30 years of age for aviation career branches)
- To pass the Air Force Officer Qualifying Test (AFQT)
- To meet academic, physical and medical standards
- To be of good moral character

b. Training

OTS has three squadrons: two for training and one for training support. One of the training squadrons conducts Basic Officer Training (BOT), while the other one is responsible for Commissioned Officer Training (COT).

BOT is a 12-week program that trains and commissions eligible college graduates to meet Air Force requirements. BOT commissions approximately 600 officers per year. However, this number may change in order to fulfill changing requirements caused by the difference between the planned and actual number of officers who are commissioned through other sources. OTS provides training in the following areas: leadership studies, professional knowledge, communication skills, military studies and

leadership. Officer trainees receive 180 hours of academic classes during the whole program. The 12-week program also includes over 80 hours of leadership activities that train officer candidates in areas such as Baseline Leadership Assessment, Confidence Course, Leadership Reaction Course, High Ropes Obstacle Course, Expeditionary Assault Course, and Air Expeditionary Force Exercise (1-week Field Leadership Exercise, during which trainees show their ability to apply the knowledge and skills learned). Once trainees fulfill all requirements, they are commissioned as Air Force officers (OTS Brochure, 2007). After OTS, most of them attend career specialty schools to receive training for a career branch.

COT is a 4.5-week program that provides officer training for non-line Air Force officers such as chaplains, medical officers, and judge advocates, who receive direct commissions according to their professional credentials (ranging from second lieutenant to colonel). COT provides training for active duty, Air National Guard and Air Force Reserve officers. Over 1,300 officers receive military and leadership training annually that includes almost 125 hours of instruction per year. Training areas are the same as those of Basic Officer Training. After completion of this training, judge advocates and chaplains attend their career specialty schools while most health professionals report to their operational units (OTS Brochure, 2007).

c. Summary

Officer Training School (OTS) offers two training programs: 12-week Basic Officer Training (BOT) and 4.5-week commissioned officer training (COT). BOT is for eligible college graduates; BOT graduates receive commissions as second lieutenants in the Air Force. COT is for non-line Air Force officers who have already received direct commissions before the training. In both programs, trainees receive initial military and leadership training. Currently, almost 19 percent of the Air Force officers are commissioned through OTS. Unlike the other commissioning sources, OTS has the ability to quickly increase or decrease output of officers to meet changing Air Force requirements.

4. Direct Appointment

Direct Appointment is for individuals who have special occupational specialties such as chaplains, judge advocates and health professionals (physicians, nurses, dentists, hospital administrators). In order to be eligible for a direct appointment, applicants must be (Air Force Instruction 36–2005, 2003):

- United States citizens
- Medically qualified
- At least 18 years old
- Have a Baccalaureate or higher degree

Eligible applicants receive commissions according to their professional credentials in their particular fields, typically ranging from second lieutenant to colonel. Required service credits for appointment to each grade are presented in Table 4.

<i>Grade</i>	<i>Required Service Credit</i>	<i>Maximum Age</i>
Second lieutenant	None	35
First lieutenant	At least 2 years	35
Captain	At least 4 years	40
Major	At least 11 years	46
Lieutenant colonel	At least 18 years	51
Colonel	At least 21 years	56

Table 4. Required Service Credits for Appointment to Each Grade (After: Air Force Instruction 36–2005, 2003).

After appointment, commissioned officers receive almost 5 weeks of initial military and leadership training at Officer Candidate School. The active duty service obligation is usually 4 years and begins on the day the applicant departs for Commissioned Officer Training (COT).

The Direct appointment program enables the Air Force to attract and commission qualified individuals for difficult-to-recruit career specialties. Direct appointments make up almost 17 percent of the current Air Force officer corps.

5. Enlisted Commissioning Programs

Enlisted commissioning programs offer qualified enlisted personnel the opportunity to be officers. The Air Force has five enlisted commissioning programs (Air Force Instruction 36–2013, 2008):

- Airman Scholarship and Commissioning Program (ASCP)
- Professional Officer Course-Early Release Program (POC-ERP)
- Scholarships for Outstanding Airman (SOAR)
- Airman Education and Commissioning Program (AECF)

The ASCP program is for all airmen who have some or no college credit. The selected applicants separate from active duty and stop receiving their military pay and benefits. They become full-time college students to obtain their Bachelor's degrees as Air Force Reserve Officer Training Corps (AFROTC) cadets. They receive funding for tuition/fees (up to \$18,000 per year), course books (\$900 per year) and other possible expenses (stipend of \$250–\$500 per year). ASCP scholarship program is offered for 2–4 years according to the amount of time that an applicant needs to complete his/her Bachelor's degree.

The POC-ERP program is for active duty airmen who can complete a Bachelor's degree and commissioning requirements within 2 years. The selected enlisted personnel separate from active duty and become AFROTC cadets to obtain their undergraduate degree as full-time college students. They only receive an annual textbook allowance of \$900 and a monthly stipend of \$250–\$500 to support their college expenses.

The SOAR program is to select high quality enlisted personnel for commissioning. Commanders nominate qualified applicants for the program. The application requirements, commissioning procedure and funding amount provided for possible college expenses are same as the ASCP program.

The AECP program is for active duty enlisted personnel who can complete undergraduate degree and commissioning requirements within 1–3 years. This program is offered for certain college majors such as mathematics, physics, computer science, meteorology, nursing, some foreign language programs and foreign area studies. Although the selected applicants become full-time college students, they remain on active duty. Therefore, they continue to receive their military pays and benefits. The Air Force also provides them with tuition/fees scholarship of up to \$15,000 per year and an annual textbook allowance of \$600. Upon graduation from the university, they attend the Basic Officer Training (BOT) course at Officer Training School (OTS). The AECP program students earn their commission after completion of the BOT course.

To be accepted for an enlisted commissioning program, an applicant (Enlisted Commissioning Programs, 2009):

- Must be a United States citizen
- Must be less than 31 years of age at the time of commissioning
- Must meet academic, physical, moral, fitness and medical requirements
- Must be recommended by his/her first commander
- Must have at least 1 year Time In Service (except for the SOAR program applicants) and 1 year Time On Station
- Must be accepted to a host/non-host Air Force ROTC institution
- Must pass Air Force Officer Qualifying Test (AFOQT) test

After successful completion of the enlisted commissioning programs, airmen earn their commissions as second lieutenants in the Air Force with a service obligation of 8 years (initial 4 years must be served on active duty). These programs enable the Air Force to promote successful experienced enlisted personnel within the service while increasing the motivation for enlisted members.

B. OFFICER CLASSIFICATION STRUCTURE AND CAREER DEVELOPMENT

After completion of their commissioning programs, most Air Force officers attend career specialty schools to receive advanced training. The Air Force Specialties (AFS) are grouped into career areas based on similarity and transferability of skills and knowledge. Career groups are:

- Operations
- Logistics
- Support
- Medical
- Professional (Chaplains and Judge Advocates)
- Acquisition and Financial Management
- Special Investigations
- Reporting Identifiers
- Special Duty Identifiers

Officers whose career areas are other than Professional and Medical are called "Line of the Air Force (LAF)" officers. The Operations career area consists of specialties that directly utilize weapon and supporting systems to achieve operational goals of the Air Force. This area includes Pilot, Navigator, Space, Missile and Command Control, Intelligence and Operations Support utilization fields.

The Logistics area is responsible for logistics duties such as supply, transportation, procurement and maintenance. The Support Career Area performs support activities such as force protection, civil engineering, communications, public affairs, information management, manpower, morale, welfare, recreation, and services.

The Medical career area includes Health Services Management, Biomedical Clinicians, Biomedical Specialists, Medicine, Surgery, Nurse, Dental, and Aerospace Medicine utilization fields. Officers in this functional area provide operational and other units with health services. The Professional career area consists of Law and Chaplain utilization fields. Chaplains do not have command authority and combatant status. They cannot be assigned to perform any other military job. Members of Professional and Medical career areas are called "non-line" officers.

The Acquisition and Financial Management career area includes Scientific Research, Developmental Engineering, Acquisition, Contracting and Financial utilization fields.

The Special Investigations career area is responsible for direction of special investigations regarding criminal, fraud, subversive and other related activities. Special Duty and Reporting Identifiers are used to identify duties or positions that are unrelated to any career field. These assigned duties may be temporary or permanent.

The Air Force uses an alphanumeric code to indicate each specialty. The officer Air Force Specialty Codes (AFSC) includes four characters:

- Career Area (Numerical)
- Utilization Field (Numerical)
- Functional Area (Alpha)
- Qualification Level (Numerical)

For instance, for AFSC **11B1**:

- The career area is 1 (Operations)
- The Utilization Field is 1 (Pilot)
- The Functional Area is B (Bomber Pilot)
- The Qualification Level is 1 (Entry/Student)

AFSCs may include prefixes or suffixes to make the AFSC more specific. For example, suffix “C” in AFSC 11B2C, specifies B-52 aircraft (AFMAN 36–2105, 2004).

After acquiring the required knowledge and skills in their specialty area, officers are assigned to operational units. The first assignments help officers improve their leadership skills and gain competence in their fields. During this qualification period, officers may be deployed several times. This period usually covers the time between the ranks of O-1 and O-3. Officers in higher grades usually occupy leadership positions and contribute to occupational development of their subordinates with their knowledge and experience.

Officers also have other opportunities to develop their knowledge and skills. Officers may be chosen to attend education programs given at institutions such as the Naval Postgraduate School, Air Force Institute of Technology and Air Command and Staff College. Attending and successfully completing these programs may improve their probability of advancement in their careers. Since deployment probabilities may vary

among officer communities due to operational requirements, and distance-learning capacities are limited, some of the career specialties may have an advantage over the others at certain grades regarding the possibility of attending these graduate programs.

C. THE AIR FORCE PROMOTION SYSTEM

The purpose of the Air Force Promotion Program is to choose enough officers of desired quality, in the proper grades, to fulfill the mission requirements. In order to accomplish this goal, the Air Force promotes a sufficient number of officers as vacancies occur. A fair and effective promotion system enables the Air Force to sustain the strength in each grade and ensures retaining a highly qualified and motivated officer force by providing reasonably consistent and visible progression patterns for all competitive categories and selects the best-qualified officers.

Most officers have to complete an average active duty service (time-in-service) before they are promoted to a particular grade. For example, officers complete 2 years of active duty service before they get promoted to the O-2 grade. These phase points are presented in Table 5:

<i>Grade</i>	<i>Time-in-service (Years)</i>
O-2 - First Lieutenant	2
O-3 – Captain	4
O-4 – Major	9–11
O-5 – Lieutenant Colonel	15–17
O-6 – Colonel	21–23

Table 5. Officer Phase Points (After: Air Force Pamphlet 36–2506, 1997)

In order to be eligible for promotion to the next grade, officers must serve in their current grades for certain time periods (time-in-grade). Basic eligibility criteria for grades are:

- A second lieutenant is considered to be eligible for promotion upon completing 24 months in grade.
- First lieutenants are promoted to captain upon completing 24 months in the grade of first lieutenant.
- Captains, majors, and lieutenant colonels are not considered in promotion zone (IPZ) for the next higher grade until they serve 3 years in their current grade.

Officers who are in the same grade and eligible for promotion consideration are grouped into promotion zones:

- In-the-promotion zone (IPZ) represents the officers' "on-time" consideration for promotion according to their date of rank. Officers have highest promotion opportunity when they are in this zone.
- Below-the promotion zone (BPZ) represents officers' early consideration for promotion. Officers in this zone are junior to officers who are IPZ.
- Above-the-Promotion Zone (APZ) represents the officers' "late" consideration for promotion. This zone includes officers who have previously failed IPZ selection to that grade. Officers in this zone are senior to officers who are IPZ.

Promotion opportunities differ among the competitive categories. According to the current directives, for the Line of the Air Force (LAF) category (the other categories are Judge Advocate (JAG), Medical Corps (MC), Dental Corps (DC), Chaplain (CHAP), Medical Service Corps (MSC), Biomedical Sciences Corps (BSC), and Nurse Corps (NC)), 100 percent of the first lieutenants can promote to the grade of captain, 90 percent of the captains can be majors, 70 percent of majors can promote to the grade of lieutenant colonel and only 50 percent of lieutenant colonels can be colonels. The maximum board quota for each grade is determined by multiplying the probability of promotion to the higher grade by the number of officers eligible IPZ. For example, if there are 1000 eligible majors IPZ, only 700 of them may promote to the grade of lieutenant colonel (70 percent multiplied by 1,000). However, the selection rate for a promotion board is generally lower than the maximum board quota.

Senior raters fill promotion recommendation forms (PRF) for officers who are on a promotion board. They can make the following recommendations: "Definitely Promote" (DP), "Promote" (P), or "Do Not Promote This Board" (DNP). Since the

number of officers that a board can select for promotion is greater than the total of DP and P recommendations, a DP or P rate does not ensure promoting to the next grade. A selection board of highly qualified senior officers with extensive experience evaluates and selects eligible officers for promotion according to the following criteria:

- Job performance responsibility and performance
- Leadership and other professional qualities
- Level of experience
- Level of academic and professional military education that develops the officer's performance
- Other specific features such as specific awards and decorations, etc.

The Air Force promotes officers according to their prospective future performance at a higher grade, rather than awarding them for past performance. Since not all officers are required in the higher grades, there are specific limitations on the number of officers who can promote (Air Force Pamphlet 36–2506, 1997).

D. RELEVANT PRIOR STUDIES

1. Kizilkaya (2004)

In his thesis, Kizilkaya analyzed the effect of commissioning sources on the retention behavior and promotion of U.S. Army officers. He looked at retention to the grade of O-4, and promotion to the grades of O-4 and O-5.

The data used in his study was developed from the Active Duty Military Master File for the Army, which tracks active-duty officers through their careers. The data sets included information about officers commissioned between 1981 and 2001. Each cohort consisted of almost 10,000 observations. Kizilkaya eliminated some of the variables that were irrelevant to the study and created pooled data sets that included variables related to demographics, and the professional and educational characteristics of the individuals.

The study utilized regression models to determine the relationship between the dependent and independent variables. Kizilkaya created and used “RETAINED” and “PROMOTED” as dependent variables in the multivariate regression models, which take

a value of 1 if the officer is retained or promoted and a value of 0 otherwise. For example, if there is any value in the pay grade column in 1995 for an observation that commissioned in 1985, the “RETAINED” variable is set equal to ‘1’. Since these variables take binary values, he preferred using logistic regression models as a tool for analysis.

The results of the regression models showed that there is relationship between the commissioning source and the retention behavior and promotion of officers in the Army. Kizilkaya found that USMA graduates are less likely to stay to the O-4 promotion board and less likely to be promoted to the grade of O-4. However, the promotion model to the grade of O-5 found that West Point graduates are more likely to be promoted than ROTC graduates and Direct Appointments. OCS graduates are more likely to be retained and promoted to the grade of O-4 than officers commissioned through other sources. The results suggested that the ROTC male graduates are more likely to stay and to be promoted to the grade of O-4 and O-5 than Direct Appointments. Other findings are listed below:

- Being married has a positive effect in all models
- Male officers are more likely to stay and to be promoted to the grade of O-4 than females
- Officers who have prior enlisted status are less likely to be promoted to the grade of O-5
- Officers with graduate degree are more likely to be promoted to the grade of O-5
- Career specialties and dependent numbers of the officers have statistically significant effects on dependent variables

Kizilkaya noted some limitations in his research, due to the lack of some information in the data sets used for analysis. For example, not having any information about officer evaluation reports and awards prevented him from controlling for these variables in his models, which made the results less robust. Another limitation of the used data set was the lack of officers commissioned through OCS between 1981 and 1983. This prevented him from analyzing the effect of being an OCS graduate on promotion to the grade of O-5.

2. Bernard (2002)

Bernard (2002) analyzed the effect of commissioning sources on the retention and promotion outcomes of Naval officers and the relative cost-effectiveness of each commissioning program. The study examined retention to the grade of O-4 promotion board, and promotion to the grade of O-4.

The study used data files from different sources and merged the files with the O-3 (LT) and O-4 (LCDR) selection board results for fiscal years 1986 through 2001. The data also included Navy Officer Data Card Information for officers commissioned from 1983 through 1990. Due to some missing information, Bernard eliminated some observations and ended up with a sample of 22,263 officers.

Bernard used logit regression models because of the non-linear relationship between the dependent and independent variables. He built two different models for each retention or promotion analysis to examine the outcomes separately for Unrestricted Line (URL) and Restricted Line (RL) Officers. This was done to prevent possible aggregation bias. The study used the following variables in the regression models: “STAY04BD” and “HPROM04”, which were binary dependent variables representing retention to the O-4 board and promotion to O-4, respectively. The explanatory variables were education level, source of commissioning, college selectivity, military occupation and demographic background. The author also created interaction variables between commissioning source dummies and college selectivity dummies. Finally, he used some other variables to account for lateral transfer of officers from one community to another.

In order to examine cost-effectiveness of the commissioning programs, Bernard used steady state cost analysis as a foundation. He calculated the required number of accessions to retain and promote one officer to the grade of O-4 based on the following formula: $1/(\text{retention rate} \times \text{promotion rate to O-4})$. The cost per O-4 from each source was then calculated by multiplying the steady state number of accessions by the total commissioning costs. Bernard analyzed cost-effectiveness by using both average and marginal pre-commissioning costs.

According to the result of his URL retention model, officers from the Naval Academy (USNA) are less likely to stay to O-4 than non-selective ROTC-Scholarship and ROTC-Contract programs and more likely to stay than non-selective OCS graduates. However, in the same retention model, Bernard also found that USNA graduates are more likely to stay than ROTC-Scholarship and OCS graduates that attended high quality colleges, which suggests that graduates of highly selective universities are more likely to seek job opportunities outside the Navy. The RL retention model suggested that ROTC and OCS graduates are more likely to stay to O-4 than USNA graduates. Although USNA graduates were found to be less likely to stay to the O-4 promotion board, they are more likely to promote to the grade of O-4 than officers from other sources.

The cost analysis revealed that the Naval Academy is the most cost-effective commissioning source in order to meet future accession increases for most of the officer communities when using marginal pre-commissioning costs. The study assumes the USNA is not operating at full capacity and, therefore, has low marginal cost of graduating one additional officer.

3. Ergun (2003)

In his thesis, Levent Ergun (2003) addressed the factors that affect career progression of U.S. Marine Corps officers. Ergun analyzed the effect of commissioning sources on officers' career development by using retention and promotion as performance measures. The study also evaluated fitness reports and performance at The Basic School (TBS).

Ergun merged three different data files. The final data set consisted of more than 28,000 Marine Corps officers who commissioned from FY 1980 through 1999. In his analysis, Ergun specified five models. He used TBS performance models and conducted analysis of variance (ANOVA) tests to analyze if there were any performance differences among graduates of different commissioning programs at TBS and utilized TBS class ranks as dependent variables in regressions.

After eliminating involuntarily leavers, the logit retention model used the binary “Retained_10YCS” variable as the dependent variable. Ergun set the value of this variable to “1” if an officer serves more than 119 months after his commissioning date. In the O-4 and O-5 promotion models, the study performed a two-step procedure using probit regressions. The first-step models examined survival to O-4 and O-5 promotion boards while the second-step models analyzed promotion to these grades. Dependent variables were binary and equal to “1” if an individual survives to the targeted promotion board or promotes to those grades. The study controlled for explanatory variables such as demographics, TBS Overall Class Rank Percentile, occupational group, commissioning source, prior enlisted status and commissioning fiscal year.

Performance Index (PI) models used ordinary least squares (OLS) regressions to estimate “PI” scores at different grades, which were constructed from officers’ fitness reports. Officers with higher “PI” scores were assumed to perform better. The primary purpose of this analysis was to find out if there are significant differences among officers from various commissioning sources regarding their fitness report scores.

The results of multivariate regressions suggest that:

- USNA graduates perform better at TBS than Platoon Leader Course (PLC) and Officer Candidate Course (OCC) graduates, but worse than those of other commissioning programs
- USNA graduates are more likely to stay to the 10-year point than PLC and OCC graduates, but less likely than those of Marine Corps Enlisted Commissioning Program (MECEP)
- USNA graduates are less likely to promote to the grade of O-4 than those of Navy ROTC (NROTC), Enlisted Commissioning Program (ECP), PLC and OCC
- USNA graduates are less likely to promote to the grade of O-5 than those of NROTC, PLC, MECEP and ECP
- USNA graduates are more likely to have better fitness report scores than those of other commissioning programs at all grades (except MECEP at O-2 grade)

4. Demirel (2002)

This study analyzed officer retention behavior in the U.S. Military. Demirel examined the effect of officer commissioning sources on retention at the point that officers have fulfilled their minimum service requirement (MSR) and at 10-years of service.

The data file used was from Defense Manpower Data Center (DMDC) and included longitudinal information of officers who commissioned between 1985 and 1995. Demirel eliminated any observations that had missing values on the variables needed for his analysis, and ended up with a data set that containing 129,168 observations from all services.

The study assumed that retention behavior of an officer is affected by factors such as personal demographics, professional and educational traits. Demirel used “STAY” as a dependent variable, which is equal to “1” if an individual stays in the military after completing his/her initial obligated service or after 10 years of service, and “0” otherwise. Since the dependent variables were binary, he estimated logit regression models. In the first retention models, he chose various retention cutoff points due to different MSRs of some occupational specialties.

The study found significant relationships between retention and commissioning sources in most of the models. According to the results of MSR Logit Retention Model for the Air Force, USAFA and ROTC non-scholarship graduates are more likely to stay in the military after completing their obligated service than those from other commissioning programs. Retention rates of various commissioning programs can be listed from the highest to the lowest as following:

- Academy
- ROTC non-scholarship
- OCS
- ROTC scholarship
- Direct Appointment

However, in the 10-year retention model, only the Direct Appointment variable was significant and graduates of this program are less likely to stay than those of ROTC scholarship program.

E. CHAPTER SUMMARY

Because officers lead their squadrons, officer quality is of great concern to the Air Force. There are five main commissioning sources for officers. Each of them has different features and costs. USAFA provides the longest military training and acculturation, whereas the OTS provides shorter military training with a relatively lower cost of commissioning and the unique ability to quickly increase or decrease output of officers to meet changing Air Force requirements. Since knowing the costs and effectiveness of officer commissioning programs are vital for the DoD, it is useful to determine whether there is any effect of commissioning source on officer performance and to determine the proper mixture of new officers from each source.

After completing a commissioning program, most officers receive professional military training according to their assigned career specialties at branch schools. The Air Force also offers other education opportunities such as graduate programs and Air Command and Staff College. Retention of qualified officers who complete these training and education programs is important for the Air Force.

The Air Force promotes its leaders according to their potential to successfully serve in the next higher position of responsibility. Only some of the eligible officers are promoted when vacancies occur, to maintain the strength of the grades. A selection board of experienced senior officers selects officers for promotion from the eligible candidates by evaluating specific features of their job performance, professional qualities and education level, among others.

Since retention of a qualified officer corps is critical and promotion based on their performance, most of the past studies used retention behavior and promotion to the targeted grades as measures of officer performance. Several previous studies analyzed the effect of commissioning source on officer career development by using multivariate regression models. Most of the results revealed significant relationship between commissioning program and officer performance.

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III. DATA AND METHODOLOGY

A. DATA

The initial data set used in this study was provided by Defense Manpower Data Center (DMDC). The analysis data set was developed from the Active Duty Military Master File (ADMMF) and the Separation File (SF) for U.S. Air Force Officers. The ADMMF contains information about demographics and professional and educational background, whereas the SF includes reasons for and dates of separation for Air Force officers who were commissioned between 1992 and 2006.

The raw data set consists of 44 variables and 55,542 observations. Personal demographics variables include unique ID, gender, race, age, marital status and number of dependents. Variables that represent professional and educational background are education, source of commissioning, pay grade, commissioning date, rank effective date, current months in grade, Air Force Specialty Code, DoD Occupational code, separation date, and Interservice separation code.

Some variables are constant over time such as gender and race, whereas others change over time, such as marital status and number of dependents. The original data set used in this thesis includes status of the officers at three time points: (1) entry, (2) separation (if occurred) and (3) current date (September 30, 2006). The data samples derived from the raw data file for descriptive and multivariate regression analysis include current status of the officers for variables that change over time. Table 6 shows the data elements included in the original data file.

<i>Category</i>	<i>Variable Definition</i>
Demographics	Gender
	Race
	Marital Status
	Age
	Number of Dependents

<i>Category</i>	<i>Variable Definition</i>
Professional and Educational Traits	Commissioning Date
	Educational Level
	Source of Commissioning
	Pay Grade
	DoD Occupational Code
	Air Force Specialty Code
	Current Date
	Separation Date
	Interservice Separation Code
	Current Months in Grade

Table 6. Variables Included in the Original Data File (Source: DMDC)

B. PRELIMINARY DATA ANALYSIS

1. Data Samples Used in Analysis

Three statistical models were constructed for analysis: (1) retention after minimum service requirement (MSR), (2) retention to the O-4 promotion board (STAY_O4) and (3) promotion to the grade of O-4. Separate data sets were created for each model by using the original data set provided by the Defense Manpower Data Center (DMDC).

Since the purpose of this research is to analyze the effect of commissioning source on career progression of Air Force Line officers, non-line Air Force personnel such as medical officers (doctors and nurses), lawyers and chaplains were deleted from the data sets. Further, observations that had missing information for the following variables were discarded: commissioning date, entry pay grade, current pay grade, current marital status, current number of dependents, current Air Force Specialty Code, current education level, source of commissioning, race, gender and date of birth.

Since only officers who are not pilots and who were commissioned between 1992 and 2000 were examined in the MSR retention model, officers from other cohorts and officers with flying status were excluded from the retention data set. Officers who had separated before completing 4 years of service and USAFA graduates who had separated before completing 5 years of service were eliminated from both retention data samples because most AFROTC and USAFA graduates incur 4 and 5 years of obligated service, respectively. Additionally, pilots who had separated before completing 9 years of service were eliminated from STAY_O4 retention model since most pilots incur at least 9 years active duty service commitment (Benton, 2005). In both retention sets, only officers who had separated from the Air Force voluntarily were kept by using Interservice Separation Codes. Officers who had the following separation codes were defined as voluntary leavers:

Interservice Separation Code	Explanation
2001	Expiration of term of service
2002	Voluntary release, to attend school or to teach
2003	Voluntary release, in the national interest
2005	Voluntary release, other, including VSI and SSB

Table 7. Interservice Separation codes for Voluntary Leavers (Source: Active Duty Military Personnel Edit File)

Officers have to complete an average active duty service period (time-in-service) before they are promoted to a particular grade. Moreover, in order to be eligible for promotion to the next grade, officers must serve in their current grades for certain time periods (time-in-grade). Captains who have completed 9 years of active duty service and 3 years of time-in-grade are considered to be eligible for promotion to the grade of O-4 (Air Force Pamphlet 36-2506, 1997). Therefore, officers commissioned between 1992 and 1997 were included in the data set created for the STAY_O4 retention model.

The promotion model uses the data set that was created for the STAY_O4 retention model after eliminating the “leavers” and officers below the pay grade of O-3. Table 8 presents the number of observations used in the samples for each of the three models.

<i>Model</i>	<i>Number of Observations</i>		
	Stayer	Leaver	Total
MSR Retention Model	10,526	1,835	12,361
STAY_O4 Retention Model	7,313	2,038	9,351
	Promoted	Not Promoted	Total
Promotion_O4 Model	5,423	1,890	7,313

Table 8. Number of Observations in Data Samples

2. Variable Definitions

a. Dependent Variables

The study uses binary “STAY_MSR” and “STAY_O4” variables as dependent variables for the retention models. The dependent variable of the first retention model, “STAY_MSR,” equals “1” if an officer stays in the military after completing his/her initial obligated service and equals “0” otherwise. In the second retention model, the dependent variable “STAY_O4” equals “1” if an officer stays to the O-4 promotion board and equals “0” otherwise.

Most USAFA graduates incur a 5-year active duty service commitment whereas most Air Force ROTC graduates have a 4-year minimum service requirement (MSR). However, some of the graduates who enter pilot, navigator or other special training for a specific career branch incur a longer commitment after they complete their training. For example, the active duty service commitment is 10 years for pilots, 6 years for navigators and Air Battle Management career field officers (Benton, 2005). Commissioned officers may request to leave the Air Force after the initial active duty

service. Since the study did not include pilots in the MSR retention model, the retention cutoff point for this model was set at 6 years of service. Officers have to complete at least 9 years of service to appear in the promotion zone to the grade of O-4. Therefore, the cutoff point for the second retention model was determined as 9 years of service.

The "SERVICEYRS" variable was created by subtracting the "Commissioning Date" variable from the "Current Date" variable, which was set equal to "09/30/2006" if an officer was still in service as of 2006 and set equal to "date of separation" otherwise. The SERVICEYRS variable was used to construct dependent variables for the retention models. If the value of the "SERVICEYRS" variable exceeds 6 or 9 for an observation, then "STAY_MSR" and "STAY_O4" are set equal to 1, respectively, and set equal to 0 otherwise.

The dependent variable of the promotion model (PROMOTED_O4) is set equal to 1 if an officer is promoted to the grade of O-4 and 0 otherwise. "Current Pay Grade" and "Separation Pay Grade" information are used to create this dependent variable. For example, if "Current Pay Grade" or "Separation Pay Grade" is O-4 or above for an officer commissioned in 1994 then "PROMOTED_O4" takes a value of 1 and a value of 0 otherwise. Table 9 presents the dependent variables and their descriptions.

<i>Dependent Variable</i>	<i>Description</i>
STAY_MSR	= 1 IF AN OFFICER STAYS IN THE MILITARY AFTER MSR = 0 IF AN OFFICER VOLUNTARILY LEAVES THE MILITARY AFTER MSR
STAY_O4	= 1 IF AN OFFICER STAYS AFTER 9 YEARS OF SERVICE = 0 IF AN OFFICER VOLUNTARILY LEAVES THE MILITARY BEFORE COMPLETING 9 YEARS OF SERVICE
PROMOTED_O4	= 1 IF AN OFFICER IS PROMOTED TO O-4 = 0 IF AN OFFICER IS NOT PROMOTED TO O-4

Table 9. Dependent Variables and Descriptions

b. Independent Variables

The explanatory variables used in the retention and promotion models include personal and professional information about the observations. The explanatory variables are AGE, RACE, SEX, MARITAL STATUS, NUMBER OF DEPENDENTS, EDUCATION LEVEL, COMMISSIONING SOURCE and AIR FORCE SPECIALTY CODE.

Some previous studies, which analyzed the effect of commissioning sources on officer performance for other military services, controlled for other relevant explanatory variables such as PERFORMANCE AT THE BASIC SCHOOL (TBS), COLLEGE SELECTIVITY, PRIOR ENLISTED EXPERIENCE (PE) and FITNESS REPORTS to build more robust models. However, due to lack of required data elements in the DMDC data set, these variables are not included in this study. Table 10 describes explanatory variables.

<i>CATEGORY</i>	<i>VARIABLE</i>	<i>DESCRIPTION</i>
DEMOGRAPHICS	COMAGE	COMMISSIONING AGE
	WHITE	IF RACE=1 THEN WHITE=1; ELSE WHITE=0
	BLACK	IF RACE=2 THEN BLACK=1; ELSE BLACK=0
	OTHERRACE	IF RACE=0 THEN OTHERRACE=1; ELSE OTHERRACE=0
	FEMALE	IF SEX=1 THEN FEMALE=1; ELSE FEMALE=0
	MALE	IF SEX=2 THEN MALE=1; ELSE MALE=0
	MARRIED	IF CMST=1 THEN MARRIED=1; ELSE MARRIED=0
	SINGLE	IF CMST=0 THE SINGLE=1; ELSE SINGLE=0
	DEP_1OR0	IF CNOD=1 THEN DEP_1OR0=1; ELSE DEP_1OR0=0
	DEP_2	IF CNOD=2 THEN DEP_2=1; ELSE DEP_2=0
	DEP_3	IF CNOD=3 THEN DEP_3=1; ELSE DEP_3=0
	DEP_4	IF CNOD=4 THEN DEP_4=1; ELSE DEP_4=0

<i>CATEGORY</i>	<i>VARIABLE</i>	<i>DESCRIPTION</i>
PROFESSIONAL AND EDUCATIONAL TRAITS	BACCALAUREATE	IF CEL=1 THEN BACCALAUREATE =1; ELSE BACCALAUREATE =0
	MASTERORABOVE	IF CEL=2 THEN MASTERORABOVE =1; ELSE MASTERORABOVE =0
	LESTHANBD	IF CEL=0 THEN LESTHANBD =1; ELSE LESTHANBD =0
	USAFA	IF COMMSOURCE=1 THEN USAFA =1; ELSE USAFA =0
	ROTC_NON_SCH	IF COMMSOURCE=2 THEN ROTC_NON_SCH =1; ELSE ROTC_NON_SCH =0
	ROTC_SCH	IF COMMSOURCE=3 THEN ROTC_SCH =1; ELSE ROTC_SCH =0
	OTSANDOTHER	IF COMMSOURCE=4 THEN OTSANDOTHER =1; ELSE OTSANDOTHER =0
	OPE	IF CURRENTAFSC=1 THEN OPE =1; ELSE OPE =0
	LOG	IF CURRENTAFSC=2 THEN LOG =1; ELSE LOG =0
	SUP	IF CURRENTAFSC=3 THEN SUP =1; ELSE SUP =0
	ACQ	IF CURRENTAFSC=4 THEN ACQ =1; ELSE ACQ =0
	SPD	IF CURRENTAFSC=5 THEN SPD =1; ELSE SPD =0

Table 10. Explanatory Variables and Descriptions

3. Descriptive Statistics

a. Data Description for MSR Retention Model

The retention beyond minimum service requirement (MSR) model consists of Air Force officers commissioned between 1992 and 2000. The data set includes 12,361 observations. According to the descriptive statistics in Table 11, most officers are male, married and white. Data analysis shows that almost 85.15 percent of the officers in the full sample stayed beyond initial service commitment.

Average age at commissioning is approximately 24.7, with a standard deviation of 3.2. Minimum and maximum ages at commissioning are 20 and 36. The retention rate of male officers is higher than the retention rate of female officers. Married officers, African American officers, officers with more than one dependent and officers with a Master's degree or above have higher retention rates than single officers, white officers, officers with no or one dependent and officers with Baccalaureate degree or below, respectively.

The majority of the officers are ROTC graduates. USAFA graduates constitute almost 18 percent, ROTC Non-Scholarship program 18 percent, ROTC Scholarship program 34 percent, and OTS and other commissioning sources 30 percent of the whole sample. Officers commissioned through OTS and other sources have the highest retention rate, 92 percent, followed closely by USAFA, 85.77 percent, ROTC Non-Scholarship, 84.67 percent, and then ROTC Scholarship, 79.09 percent. According to these statistics, commissioning through OTS and USAFA may have more positive influence on retention behavior beyond the minimum service requirement than does commissioning through ROTC programs.

Statistics indicate that approximately 36 percent of officers are in the Operations career field, followed by Support, Acquisition, Logistics and Special Duty career fields at 28, 23, 12 and 1 percent, respectively. Officers from the Operations and Logistics career fields have higher retention rates than officers from other career fields.

Some variable categories contain 1 percent of the pooled sample. Officers whose races are not white or black, officers with less than Baccalaureate degrees, and officers from the Special duty career field comprise 0.6 percent, 0.5 percent and 1.1 percent of the data set, respectively. Results for these factors are likely to be statistically insignificant due to small population size.

<i>Variable</i>	<i>Variable</i>	<i>N</i>	<i>%</i>	<i>Stayers</i>	<i>Leavers</i>	<i>Retention %</i>
COMAGE	Mean= 24.75 Standard Deviation= 3.22 Min= 20 Max= 36					
SEX	FEMALE	2,180	0.1764	1,678	502	0.7697
	MALE	10,181	0.8236	8,848	1,333	0.8691
CMST	SINGLE	2,971	0.2404	2,208	763	0.7432
	MARRIED	9,390	0.7596	8,318	1,072	0.8858
RACE	OTHERRACE	75	0.0061	62	13	0.8267
	WHITE	11,202	0.9062	9,528	1,674	0.8506
	BLACK	1,084	0.0877	936	148	0.8635
CEL	LESSTHANBD	58	0.0047	44	14	0.7586
	BACCALAUREATE	6,110	0.4943	4,648	1,462	0.7607
	MASTERORABOVE	6,193	0.5010	5,834	359	0.9420
CNOD	DEP_1OR0	5,814	0.4704	4,407	1,407	0.7580
	DEP_2	2,068	0.1673	1,845	223	0.8922
	DEP_3	2,709	0.2192	2,554	155	0.9428
	DEP_4	1,770	0.1432	1,720	50	0.9718
COMMSOURCE	USAFA	2,207	0.1785	1,893	314	0.8577
	ROTC_NON_SCH	2,205	0.1784	1,867	338	0.8467
	ROTC_SCH	4,238	0.3429	3,352	886	0.7909
	OTSANDOTHER	3,711	0.3002	3,414	297	0.9200
CURRENTAFSC	OPE	4,504	0.3644	3,982	522	0.8841
	LOG	1,426	0.1154	1,264	162	0.8864
	SUP	3,412	0.2760	2,809	603	0.8233
	ACQ	2,883	0.2332	2,359	524	0.8182
	SPD	136	0.0110	112	24	0.8235
TOTAL		12,361	1	10,526	1,835	0.8515

Table 11. Descriptive statistics for MSR Retention Model

b. Data Description for STAY_O4 Retention Model

The retention to the O-4 promotion board (STAY_O4) model analyzes 9,351 Air Force officers commissioned between 1992 and 1997. Similar to the minimum service requirement retention model (MSR), the majority of the sample is comprised of white, married and male officers. The overall retention rate for the whole sample is lower than in the previous retention model. Almost 78 percent of the officer cohorts stayed to the promotion board of O-4.

Male officers have a higher retention rate than female officers. The retention rate for married officers is almost 25 percent higher than single officers. There are only nine officers who are not white or African American in the data set and all of them stay to the O-4 promotion board. Since there was no change in retention behavior for these officers, they were not included in analysis. The retention rates of white and black officers are similar. Officers who hold Master's degrees or above have almost 20 percent and 54 percent higher retention rates than officers who hold Baccalaureate degrees and less than Baccalaureate degrees, respectively. It appears that Air Force officers with higher educational degrees prefer to seek career opportunities in the service. The proportion of officers who have no or one dependent is almost 10 percent less than the sample for the MSR retention model, and the retention rates for officers who have more than one dependent are higher than the retention rate of officers with no or one dependent. Having more dependents may have a greater positive effect on the retention decisions of officers. Age at commissioning ranges between 20 and 36, with a mean of 24.04 and a standard deviation of 2.64.

Almost one-third of officers were commissioned through the ROTC Scholarship program. USAFA graduates comprise the second biggest accession group at 26.54 percent. Officers commissioned through OTS and other sources make up 21.35 percent whereas ROTC Non-Scholarship program graduates constitute the smallest group in the sample at 19.2 percent. The retention to the O-4 promotion board model includes fewer officers commissioned through OTS and other sources and more USAFA graduates compared to the MSR retention sample. There are small differences in retention rate among officers from different commissioning sources. Officers commissioned through OTS and other sources have the highest retention rate, at 83.97 percent, whereas ROTC Scholarship graduates have the lowest retention rate, at 73.07 percent. The ranking of the commissioning sources, from the highest retention rate to the lowest, is similar to the MSR retention model as follows: OTSANDOTHER-USAFA-ROTC_NON_SCH-ROTC_SCH. Statistics indicate that officers commissioned through OTS and other sources may be more likely to stay to the O-4 promotion board than the other commissioning groups.

The majority of officers, 53 percent, serve in the Operations career field. Officers from the Support career field constitute almost 20 percent, Acquisition career field 18 percent, Logistics career field 8 percent and Special Duty, 1 percent. The percentage of officers who are from the Operations career field increases by 17 percent (from 36 percent to 53 percent), whereas it decreases for officers from other career fields compared to the MSR retention model. Officers from the Operations career field have the highest retention rate at 87.03 percent, which is almost 10, 20, 23 and 27 percent higher than officers from the Logistics, Support, Acquisition and Special Duty career fields, respectively. Being in the Operations career field may positively affect retention behavior to the O-4 promotion board. Table 12 presents frequencies and retention rates for the STAY_O4 model.

<i>Variable</i>	<i>Categories</i>	<i>N</i>	<i>%</i>	<i>Stayers</i>	<i>Leavers</i>	<i>% Retention</i>
COMAGE	Mean= 24.04 Standard Deviation= 2.64 Min= 20 Max= 36					
SEX	FEMALE	1,176	0.1258	744	432	0.6327
	MALE	8,175	0.8742	6,569	1,606	0.8035
CMST	SINGLE	1,884	0.2015	1,109	775	0.5886
	MARRIED	7,467	0.7985	6,204	1,263	0.8309
RACE	OTHERRACE	9	0.0010	9	0	1.0000
	WHITE	8,747	0.9354	6,850	1,897	0.7831
	BLACK	595	0.0636	454	141	0.7630
CEL	LESSTHANBD	21	0.0022	7	14	0.3333
	BACCALAUREATE	4,282	0.4579	2,865	1,417	0.6691
	MASTERORABOVE	5,048	0.5398	4,441	607	0.8798
CNOD	DEP_1OR0	3,792	0.4055	2,363	1,429	0.6232
	DEP_2	1,654	0.1769	1,346	308	0.8138
	DEP_3	2,375	0.2540	2,160	215	0.9095
	DEP_4	1,530	0.1636	1,444	86	0.9438
COMMSOURCE	USAFA	2,482	0.2654	1,972	510	0.7945
	ROTC_NON_SCH	1,795	0.1920	1,416	379	0.7889
	ROTC_SCH	3,078	0.3292	2,249	829	0.7307
	OTSANDOTHER	1,996	0.2135	1,676	320	0.8397
CURRENTAFSC	OPE	4,918	0.5259	4,280	638	0.8703
	LOG	760	0.0813	587	173	0.7724
	SUP	1,894	0.2025	1,305	589	0.6890
	ACQ	1,686	0.1803	1,085	601	0.6435
	SPD	93	0.0099	56	37	0.6022

<i>Variable</i>	<i>Categories</i>	<i>N</i>	<i>%</i>	<i>Stayers</i>	<i>Leavers</i>	<i>% Retention</i>
TOTAL		9,351	1	7,313	2,038	0.7821

Table 12. Descriptive Statistics for STAY_O4 Model

c. Data Description for Promotion Model

The O-4 promotion model consists of Air Force officers commissioned between 1992 and 1997. The data set used in the analysis only includes “stayers” from the O-4 promotion board (SYAY_O4) model, which consists of 7,313 officers. Statistics presented below in Table 13 show that the majority of the officers are male, married and white, which was the same as in the data sets used for the retention models. Approximately 74 percent of the officers were promoted to the grade of O-4.

Age at commissioning ranges between 20 and 36 with a mean value of 24.2 and a standard deviation of 2.8. Similar to the retention sample, male and married officers have higher promotion rates than both female and single officers. White officers have higher promotion rates than black officers. Officers who have a Master’s or above degree constitute 60.7 percent of the sample and followed by officers with only a Baccalaureate degree at 39.1 percent. According to the statistics, advanced degrees are associated with higher promotion rates. Officers who are not from white or black category and officers with less than Baccalaureate degrees make up only 0.1 percent of the sample. Results for these factors are likely to be statistically insignificant due to such a small population size.

ROTC Scholarship program graduates constitute almost 31 percent, USAFA graduates 27 percent, OTS/other 23 percent and ROTC Non-Scholarship graduates 19 percent of the promotion data set. Commissioning source categories, from highest to lowest promotion rates, are listed as follows: OTS/other, ROTC Non-Scholarship, USAFA and ROTC Scholarship. Officers commissioned through OTS/other have almost 15 and 20 percent higher promotion rates than USAFA and ROTC

Scholarship program graduates, respectively. Officers commissioned through OTS/other are more likely to promote to the grade of O-4, according to preliminary data analysis.

The composition of officers across career specialty categories is similar to those of retention models. The Operations category comprises almost 58 percent; Support, 18 percent; Acquisition, 15 percent; Logistics, 8 percent; and Special Duty, 1 percent of the whole sample. There are small differences among officers from various career fields regarding the promotion rates. Table 13 shows descriptive statistics for the promotion model.

<i>Variable</i>	<i>Categories</i>	<i>N</i>	<i>%</i>	<i>Promoted</i>	<i>Not Promoted</i>	<i>% Retention</i>
COMAGE	Mean= 24.2 Standard Deviation= 2.8 Min= 20 Max= 36					
SEX	FEMALE	744	0.1017	517	227	0.6949
	MALE	6,569	0.8983	4,906	1,663	0.7468
CMST	SINGLE	1,109	0.1516	752	357	0.6781
	MARRIED	6,204	0.8484	4,671	1,533	0.7529
RACE	OTHERRACE	9	0.0012	6	3	0.6667
	WHITE	6,850	0.9367	5,104	1,746	0.7451
	BLACK	454	0.0621	313	141	0.6894
CEL	LESSTHANBD	7	0.0010	3	4	0.4286
	BACCALAUREATE	2,865	0.3918	1,762	1,103	0.6150
CEL	MASTERORABOVE	4,441	0.6073	3,658	783	0.8237
CNOD	DEP_1OR0	2,363	0.3231	1,573	790	0.6657
	DEP_2	1,346	0.1841	960	386	0.7132
	DEP_3	2,160	0.2954	1,698	462	0.7861
	DEP_4	1,444	0.1975	1,192	252	0.8255
COMMSOURCE	USAFA	1,972	0.2697	1,396	576	0.7079
	ROTC_NON_SCH	1,416	0.1936	1,091	325	0.7705
	ROTC_SCH	2,249	0.3075	1,505	744	0.6692
	OTSANDOTHER	1,676	0.2292	1,431	245	0.8538
CURRENTAFSC	OPE	4,280	0.5853	3,099	1,181	0.7241
	LOG	587	0.0803	444	143	0.7564
	SUP	1,305	0.1784	1,014	291	0.7770
	ACQ	1,085	0.1484	823	262	0.7585
	SPD	56	0.0077	43	13	0.7679
TOTAL		7,313	1	5,423	1,890	0.7416

Table 13. Data Description for Promotion Model

C. METHODOLOGY

The study utilizes multivariate regression models for analysis of the three outcome variables. The purpose of the regression analysis is to estimate how the value of the dependent variable is affected when one of the explanatory variables varies (holding all the other variables constant). As stated in the data analysis section, three regression models were specified to find out if there is any relationship between commissioning source and job performance of Air Force officers using retention and promotion as performance measures in accordance with the literature. In addition to the commissioning source variables, the study controls for other independent variables that represent personal demographics and professional background to isolate the effect of commissioning source on retention or promotion.

The first retention model analyzes the effect of commissioning source on voluntary retention decisions at the end of the minimum service requirement (MSR). Since officers commissioned through ROTC and OTS/other incur a 4-year commitment while USAFA graduates incur a 5-year commitment, retention to 6 years was used for the MSR retention model. An officer who had stayed 6 years or more was considered as a “stayer.” Officers who voluntarily left the service after MSR were considered as “leavers.” The STAY_O4 retention model examines the effect of commissioning source on retention to the O-4 promotion board. Officers who had stayed long enough to appear in the O-4 promotion board were considered as “stayers.” In this model, 9-years was the cutoff point since an officer must complete at least 9 years of commissioned service to be promoted to Major. Officers who had voluntarily separated before completing 9 years of service were considered as “leavers.” Since the current date was recorded as “30/09/2006” in all data sets used in analysis, only officers commissioned between 1992 and 2000, and between 1992 and 1997, were analyzed in the first and second retention models, respectively.

The promotion model analyzes a sample of officers who have more than 9 years of service and were initially commissioned between 1992 and 1997. An officer who was

promoted to the grade of O-4 was treated as “promoted.” Officers whose pay grades were still O-3 as of current date or separation date were treated as “not promoted.”

The multivariate models were specified as non-linear logistic (or ‘logit’) models. The models provide estimates of the effect of a one-unit change in each independent variable on the probability of retention and promotion. The models were estimated using STATA 10.1 data analysis software.

1. Theoretical Model

Since the goal of the research is to predict the probability of retention or promotion, either Linear Probability Models (LPM) or Logit Models (LM) can be used. LPM is a multiple regression model with a binary dependent variable. The general formula is linear in the parameters (Wooldridge, 2009, pp. 68–105).

LPM utilizes the Ordinary Least Squares (OLS) estimation technique to estimate the following equation:

$$\hat{y} = b_0 + b_1X_1 + b_2X_2 + \dots + b_iX_i$$

where \hat{y} is the predicted probability of the outcome measure and b_0 is the predicted probability of the outcome when all independent variables take the value of 0. The coefficient b_1 is the predicted change in the probability of the outcome when the independent variable X_1 increases by one unit (holding other variables fixed). LPM estimates are easy to interpret but has two major drawbacks:

- The model allows the dependent variable to take values outside the boundary of 0 and 1. Fitted probabilities can be found as “-0.2” or “5”, both of which are meaningless.
- LPM is linear and therefore assumes constant marginal effects for changes in the independent variables.

The above limitations can be overcome by using logistic regression models (LM). LM models the probability of an outcome as in the following equation (Wooldridge, 2009, pp. 575–586):

$$P(y=1/X) = G(\beta_0 + \mathbf{x}\beta)$$

“G” is a function that takes values strictly between 0 and 1: “ $0 < G(z) < 1$ ” for all real numbers “z”. The logit model uses following G (z) function:

$$G(z) = \exp(z) / [1 + \exp(z)] = \Lambda(z)$$

“G (z)” is a cumulative distribution function (cdf) for a standard random variable and is non-linear. Since the LM is non-linear, OLS estimation techniques cannot be applied. Thus, the logit model utilizes maximum likelihood estimation (MLE) to estimate the coefficients instead of OLS. The equation of logistic regression is similar to the linear regression except for the dependent variable:

$$\ln(\hat{y}) = b_0 + b_1X_1 + b_2X_2 + \dots + b_iX_i$$

where

$$\hat{y} = \text{predicted odds ratio} = (\text{Probability of event} / 1 - \text{Probability of event})$$

$$\ln(\hat{y}) = \text{natural logarithm of the predicted odds ratio}$$

$$X_1, X_2, \dots, X_i \text{ are the explanatory variables}$$

$$b_0, b_1, b_2, \dots, b_i \text{ are the estimated coefficients of the independent variables.}$$

Unlike LPM, it is difficult to interpret the estimated coefficients for a logit model. The coefficients are only used to describe the sign of the effect. If a coefficient is positive, an increase in that explanatory variable will result in an increase in the probability of the outcome. However, it is possible to get partial effects of changes in the independent variables on the probability of the outcome using STATA 10.1. Moreover, marginal effects of independent variables are not assumed to be constant, as in the LPM model. Since the logit model overcomes all the limitations of the linear probability model, this study prefers using the logistic regression theoretical model to LPM for analysis in accordance with literature.

2. MSR Retention Model

The MSR retention model uses STAY_MSR as the dependent variable in logistic regressions. STAY_MSR is set equal to “1” if an officer stays in the military after completing his/her initial obligated service and “0” otherwise. The equation for the logit model used is presented below:

$$\begin{aligned} \ln(\text{STAY_MSR}) = & \beta_0\text{COMAGE} + \beta_1\text{FEMALE} + \beta_2\text{SINGLE} + \beta_3\text{BLACK} + \\ & \beta_4\text{OTHERRACE} + \beta_5\text{LESSTHANBD} + \beta_6\text{MASTERORABOVE} + \beta_7\text{DEP_2} + \\ & \beta_8\text{DEP_3} + \beta_9\text{DEP_4} + \beta_{10}\text{ROTC_NON_SCH} + \beta_{11}\text{USAFA} + \\ & \beta_{12}\text{OTSANDOTHER} + \beta_{13}\text{LOG} + \beta_{14}\text{SUP} + \beta_{15}\text{ACQ} + \beta_{16}\text{SPD} + \varepsilon \end{aligned}$$

Dummy variables that were chosen as a baseline for categorical variables are listed in Table 14.

<i>Categorical Variable</i>	<i>Reference Category</i>
SEX	MALE
RACE	WHITE
MARITAL STATUS	MARRIED
EDUCATION LEVEL	BACCALAUREATE
NUMBER OF DEPENDENTS	DEP_1OR0
COMMISSIONING SOURCE	USAFA
AIR FORCE SPECIALTY CODE	OPE

Table 14. Reference Categories for Dummy Variables

3. Retention to the O-4 Promotion Board Model

The STAY_O4 variable was utilized as the dependent variable in the O-4 retention model. It takes a value of “1” if an officer stays to the O-4 promotion board and “0” otherwise. This retention model uses the same dummy variables as references as in Table 14. The explanatory variable OTHERRACE was dropped during regression

analysis since all officers had “1” as the value for the predicted dependent variable. The logit model used in analysis is specified as below:

$$\begin{aligned} \ln(\text{STAY_O4}) = & \beta_0 \text{COMAGE} + \beta_1 \text{FEMALE} + \beta_2 \text{SINGLE} + \beta_3 \text{BLACK} + \\ & \beta_4 \text{LESSTHANBD} + \beta_5 \text{MASTERORABOVE} + \beta_6 \text{DEP_2} + \beta_7 \text{DEP_3} + \beta_8 \text{DEP_4} \\ & + \beta_9 \text{ROTC_NON_SCH} + \beta_{10} \text{USAFA} + \beta_{11} \text{OTSANDOTHER} + \beta_{12} \text{LOG} + \beta_{13} \text{SUP} \\ & + \beta_{14} \text{ACQ} + \beta_{15} \text{SPD} + \varepsilon \end{aligned}$$

4. The O-4 Promotion Model

The dependent variable of the O-4 promotion model is PROMOTED_O4, which is set equal to "1" if an officer is promoted to the O-4 and "0" otherwise. Officers who stay to the O-4 promotion board constitute the data set used for logistic regressions. The model specification is presented below:

$$\begin{aligned} \ln(\text{PROMOTED_O4}) = & \beta_0 \text{COMAGE} + \beta_1 \text{FEMALE} + \beta_2 \text{SINGLE} + \beta_3 \text{BLACK} + \\ & \beta_4 \text{OTHERRACE} + \beta_5 \text{LESSTHANBD} + \beta_6 \text{MASTERORABOVE} + \beta_7 \text{DEP_2} + \\ & \beta_8 \text{DEP_3} + \beta_9 \text{DEP_4} + \beta_{10} \text{ROTC_NON_SCH} + \beta_{11} \text{USAFA} + \\ & \beta_{12} \text{OTSANDOTHER} + \beta_{13} \text{LOG} + \beta_{14} \text{SUP} + \beta_{15} \text{ACQ} + \beta_{16} \text{SPD} + \varepsilon \end{aligned}$$

5. Hypothesized Effects of the Explanatory Variables

One continuous and seven categorical explanatory variables are included in the analysis. It is assumed that each of the independent variables has a relationship with the dependent variable for each logit model. Table 15 shows the hypothesized effects of the explanatory variables with respect to the base variables. A positive sign of a coefficient means that an increase in that variable is associated with an increase in the probability of the retention or promotion.

Independent Variable	Dummy Variable	Description	Hypothesized Effects		
			<i>STAY_MSR</i>	<i>STAY_O4</i>	<i>PROMOTED_O4</i>
AGE (COMAGE)	-	AGE AT COMMISSIONING	+	+	+
RACE	WHITE	1 IF THE OFFICER IS WHITE	BASE CASE		
	BLACK	2 IF THE OFFICER IS BLACK	+	+	?
	OTHERRACE	0 IF OTHER RACE	+	NA	?
SEX	FEMALE	1 IF THE OFFICER IS FEMALE	-	-	-
	MALE	2 IF THE OFFICER IS MALE	BASE CASE		
MARITAL STATUS (CMST)	MARRIED	1 IF THE OFFICER IS MARRIED	BASE CASE		
	SINGLE	0 IF THE OFFICER IS NOT MARRIED	-	-	?
NUMBER OF DEPENDENTS (CNOD)	DEP_1OR0	IF THE OFFICER HAS 1 OR NO DEPENDENT	BASE CASE		
	DEP_2	2 IF THE OFFICER HAS 2 DEPENDENT	+	+	+
NUMBER OF DEPENDENTS (CNOD)	DEP_3	3 IF THE OFFICER HAS 3 DEPENDENT	+	+	+
	DEP_4	4 IF THE OFFICER HAS 4 OR MORE DEPENDENT	+	+	+
EDUCATION LEVEL (CEL)	BACCALAUREATE	1 IF THE OFFICER HAS A BACCALAUREATE DEGREE	BASE CASE		
	MASTERORABOVE	2 IF THE OFFICER HAS A MASTER'S DEGREE OR ABOVE	+	+	+

	LESSTHANBD	0 IF LESS THAN BACCALAUREATE	-	-	-
Independent Variable	Dummy Variable	Description	Hypothesized Effects		
			<i>STAY_MSR</i>	<i>STAY_O4</i>	<i>PROMOTED_O4</i>
COMMISSIONING SOURCE (COMMSOURCE)	USAFA	1 IF THE OFFICER IS AN USAFA GRADUATE	BASE CASE		
	ROTC_NON_SCH	2 IF THE OFFICER IS AN ROTC NON- SCHOLARSHIP PROGRAM GRADUATE	-	-	-
	ROTC_SCH	3 IF THE OFFICER IS AN ROTC SCHOLARSHIP PROGRAM GRADUATE	-	-	-
	OTSANDOTHER	4 IF THE OFFICER IS COMMISSIONED THROUGH OTS OR OTHER PROGRAMS.	+	+	+/-
AIR FORCE SPECIALTY CODE (CURRENTAFSC)	OPE	1 IF OPERATIONS	BASE CASE		
	LOG	2 IF LOGISTICS	-	-	?
	SUP	3 IF SUPPORT	-	-	?
	ACQ	4 IF ACQUISITION	-	-	?
	SPD	5 IF SPECIAL DUTY	-	-	?

Table 15. Hypothesized Effects of Explanatory Variables on Dependent Variables

AGE is a continuous variable and is expected to have a positive effect on retention because higher age at commissioning may be associated with higher level of military experience. More experienced officers may be more confident about success in the military and therefore may prefer to stay longer. Many of those officers will have prior-enlisted status and be more accustomed to the military life style. Additionally, older officers may be more reluctant to make career changes. However, since higher age may

be due to prior-enlisted status and be associated with longer time in the military, those officers may prefer the retirement option to retention to O-4. The expected effect of higher age at commissioning on the PROMOTED_O4 dependent variable is similar to those of retention models. Longer prior service time and more previous military experience may give officers more opportunities for career improvement and therefore increase the probability of promotion.

RACE is categorized as "White," "Black" and "Otherrace" in the samples. The majority and the baseline case is the "White" category. The expected signs of minority categories relative to the base community are positive for the retention models. The military may be perceived to offer more equal job opportunities than the civilian sector by minorities and therefore they may prefer to stay in the military. In regard to the promotion model, the hypothesized effects of the "race" dummy variables are not clear. However, findings suggest that the promotion rate to Major is lower for minorities than for whites.

SEX is measured by a binary variable for female. Since females are likely to have more responsibilities in a typical family, female officers are expected to have a lower probability of staying in comparison to male officers. Moreover, when they reach the O-4 promotion board, female officers may be less likely to get promoted, perhaps because the Air Force offers fewer career opportunities to female officers.

MARITAL STATUS is a categorical variable, with married as the reference category. Being single is assumed to have a negative effect on retention in comparison to being married when other factors are held fixed, because, single officers are less concerned about job stability. Preliminary data analysis shows higher retention rates for married officers than single officers. However, the difference between the two categories is relatively smaller regarding the promotion rates. Therefore, the effect of being single on promotion is not clear.

The NUMBER OF DEPENDENTS variable comprises four categories. 'Dep1or0' is the base case and represents officers who have 1 or no dependent. Since officers with more dependents are considered to have more family responsibilities and probably a

greater desire for job stability, they are more likely to stay in the military than officers with no or one dependent. For these same reasons, we expect having more dependents to have a positive effect on promotion.

EDUCATION LEVEL is a categorical variable with Baccalaureate degree as the reference category. It is expected that higher educational degrees are associated with higher retention and promotion probabilities as compared to the base case. Education improves the knowledge and the skills of individuals and therefore makes them more competitive among their peers in terms of career progression in both the military and the civilian sectors. However, it is assumed that the Air Force is more attractive than the civilian sector to more highly educated officers as it credits the value of training and offers officers desirable career opportunities. Preliminary data analysis also finds out that retention and promotion rates increase as education increases.

COMMISSIONING SOURCE consists of four dummy variables, each of which represents a major accession program. The USAFA is the reference category in the regressions. Officers commissioned through OTS/other are expected to have a higher probability for retention and promotion according to the preliminary data analysis. The majority of OTS graduates are prior enlisted service members and they probably have more time-in-service, experience and taste for the military than officers from the other sources. Therefore, they tend to stay longer with respect to the base case. However, in regards to promotion probabilities, they may be less likely to be promoted than the base case because of the higher military education and training received by USAFA graduates. Officers commissioned through USAFA are expected to have higher retention and promotion probabilities than ROTC programs. As noted, USAFA graduates have a longer and comprehensive military training and education period, which makes them better equipped at the beginning in relation to the graduates of other sources. They are also considered to have stronger taste for the military since they had showed their desire to be an officer at a young age by attending and completing the Air Force Academy.

AIR FORCE SPECIALTY CODE is categorized into five career fields, with a dummy variable for each career field. Since the Operations career field is the largest group, it is chosen as the reference category. According to the initial data analysis, other

career field categories have lower retention rates as compared to the base case. One reason may be that Operations career field members get more specific military training than general training, which is considered to be also beneficial for other employers outside the military. Since members of other career fields have more general training and thus better civilian opportunities, they may be less likely to stay in the Air Force compared to the Operations career field. However, there were small differences in promotion rates among various career branches in the preliminary data analysis.

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IV. RESULTS

A. BACKGROUND

As discussed in Chapter III, three logistic regression models were specified to analyze the relationship between commissioning source and officer performance, using retention and promotion as the performance measures. The study uses a set of independent variables that represent personal, professional and educational backgrounds of officers to estimate the effects of those factors on the retention and promotion outcomes.

In logit regression models, interpretation of the results is different from classic linear OLS regression models. The estimated logit coefficients of the independent variables only describe the sign of the effect of each explanatory variable on the probability of the outcome whereas they give both sign and magnitude of the effects in Ordinary Least Squares (OLS) regressions results. However, as discussed in the “Theoretical Model” section of Chapter III, it is possible to get the magnitude of the partial effects for logit models by estimating the marginal effects of each coefficient. Therefore, this study conducts a two-step analysis. In the first step, the sign of the effects are calculated with logistic regressions, and in the second step, partial effects are calculated.

B. MSR RETENTION MODEL

The first retention model examines the effect of officer accession source on retention at MSR. This model analyzes 12,361 Air Force Line officers (excluding pilots), of which 10,526 stayed in the service after expiration of the initial service commitment and 1,835 voluntarily separated. Overall retention rate for the data sample used for analysis is 85 percent. Table 16 presents the likelihood ratio statistic and p-value for the overall model, as well as the coefficients (maximum likelihood estimates), standard errors and significance levels for each of the independent variables.

MSR Retention Model		
Dependent Variable : STAY_MSR Number of Observations : 12,361		
<i>Independent Variables</i>	<i>Coefficients</i>	<i>Standard Errors</i>
COMAGE	0.1292031	0.015139***
FEMALE	-0.2980551	0.065803***
SINGLE	-0.1553529	0.064418**
BLACK	0.3944202	0.101359***
OTHERRACE	0.0397734	0.328069
LESSTHANBD	0.0871049	0.329356
MASTERORABOVE	1.585275	0.066391***
DEP_2	0.6553571	0.087022***
DEP_3	1.070681	0.09919***
DEP_4	1.686171	0.155882***
ROTC_SCH	-0.6162022	0.078593***
ROTC_NON_SCH	-0.5814962	0.095721***
OTSANDOTHER	-0.3883342	0.111824***
LOG	-0.2470081	0.102869**
SUP	-0.7323435	0.071485***
ACQ	-0.9941002	0.076033***
SPD	-0.8799333	0.254505***
Intercept	-1.31436	0.344899***
<i>Likelihood Ratio Statistic = 1925.90, Degrees of Freedom = 17, p-value = 0.0000</i>		
<i>Pseudo R-squared = 0.1855</i>		
* significant at 10%; ** significant at 5%; *** significant at 1%		

Table 16. MSR Retention Logit Model Results

Goodness-of-fit of a model describes how well the model fits the data. Goodness-of-fit measures that were used to validate the MSR retention model are the likelihood-ratio (LR) test and Pseudo R-squared value. The null hypothesis (H) in a LR test states that independent variables jointly have no effect on the dependent variable whereas the alternative hypothesis states that at least one of these variables affects the probability of retention. Since the logit MSR retention model has a likelihood ratio statistic = 1925.9 with 17 degrees of freedom and a prob > chi-squared = 0, there is sufficient evidence to reject the H. It is concluded that at least one of the explanatory variables affects the response variable, STAY_MSR.

The Pseudo R-squared is based on how close the fitted values are to actual observed values (Wooldridge, 2009, pp. 575–586). It is equal to 0.1855 for the MSR retention model. In a logit regression model, the usual R-squared shows the percentage of variation in the dependent variable that is explained by the independent variables. Adding such explanatory variables as “Prior Enlisted Status” and “Performance at the Basic School” to the model would possibly increase the R-squared. However, increasing the value of R-squared is not that important since the concern of the study is to obtain statistically significant estimates of the independent variables on the dependent variables.

1. Interpretation of the Coefficients

All of the explanatory variables in the MSR retention model are categorical variables except COMAGE. There are 16 dummy variables. The coefficient of a dummy variable is evaluated with respect to the reference category chosen for that specific independent variable. All of the independent variables were found to be statistically significant, except OTHERRACE and LESSTHANBD.

COMAGE was statistically significant at the 1 percent level and had a positive sign. Therefore, the coefficient of this variable indicates that an increase in age at commissioning of one year is associated with an increase in the probability of retention beyond MSR, which is consistent with the hypothesized effect of this variable. That is, officers who are older at commissioning are more likely to stay in the Air Force after completing their initial service commitment.

The FEMALE dummy variable was statistically significant at the 1 percent level. Since the sign of the coefficient is negative, it suggests that female officers are less likely to stay in the military after the minimum service requirement expires than are male officers. The result is consistent with the hypothesized effect and similar to the findings of relevant prior studies.

The SINGLE dummy variable is statistically significant and had a negative sign, indicating that officers who are single are less likely to stay in the Air Force in comparison to married officers. Therefore, we can conclude that marital status plays a role in MSR retention behavior.

Among the RACE categories, the OTHERRACE dummy variable was statistically insignificant, which may be due to the small sample size. There were only 75 officers in the OTHERRACE category, 62 of whom stayed in the service after MSR. However, when a test was performed to see whether both of the RACE categories were jointly significant in the model, it was found that the OTHERRACE and BLACK variables together were statistically significant at the 1 percent level with a chi-squared = 15.14 and $p\text{-value} > \chi^2 = 0.0005$. Since BLACK was found to be statistically significant at 1 percent, it is concluded that African American officers are more likely to stay after the initial MSR than white officers. This finding supports the hypothesized effect of the RACE variable as minorities were hypothesized to stay longer in the military.

All of the NUMBER OF DEPENDENTS dummy variables, DEP_2, DEP_3 and DEP_4, were found to be statistically significant at the 1 percent level indicating that officers with more than one dependent are more likely to stay in the Air Force at MSR expiration. The results are consistent with the hypothesized effect of number of dependents on the probability of retention, and findings of prior studies.

Only one of the explanatory variables that represent the education levels of Air Force officers was statistically significant. Since the sign of MASTERORABOVE variable is positive, the author concludes that officers with advanced degrees are more likely to stay in the military than officers with Baccalaureate degrees. The coefficient of the LESSTHANBD variable was insignificant. However, there were only 58 observations from this category in the sample. Officers with advanced degrees may prefer to seek career opportunities inside the military rather than in the civilian labor market because of the increased military career benefits. The results are consistent with the hypothesized effects.

In regard to the main focus of this study, all three commissioning source variables were found to be statistically significant at the 1 percent level as compared to the Air Force Academy. Therefore, it may be concluded that USAFA graduates are more likely to stay in the Air Force after the obligated service in comparison to the graduates of other commissioning sources. Officers commissioned through OTS, and other sources except

ROTC programs, were assumed to be more likely to stay after MSR in comparison to USAFA graduates, since the majority of them probably had prior enlisted service. The hypothesized probability of staying longer than USAFA graduates for OTSANDOTHER category may have been offset by the relatively longer military training and education received by USAFA graduates, which benefits them regarding career progress at the beginning, and the higher military propensity of USAFA graduates. ROTC program graduates were found to be less likely to stay than the USAFA graduates, which was as expected.

The Career field dummy variables were statistically significant. The Operations career field was the baseline category. All of the career field categories have negative signs and, therefore, it can be concluded that officers from the Operations career field are more likely to stay in the service than officers from the Logistics, Support, Acquisition and Special Duty career fields. The results are consistent with the hypothesized effects of the career field variables on the probability of retention. It was assumed that officers from career field categories other than Operations might be less likely to stay since the education and training received by those officers are more general, which makes them more valuable in the civilian sector.

2. Marginal Effects of the Independent Variables

The marginal effect of each coefficient in a logit regression is calculated via the STATA software, and the effects are interpreted with respect to the reference category. In the MSR model, the base case is an officer who is at the average age of 24.75, male, married and white, with no or one dependent, with Baccalaureate degree, commissioned through USAFA and in the Operations career field. According to the Table 17, the base officer has a probability of staying in the Air Force beyond MSR of 90.9 percent.

Marginal Effects for the MSR Retention Model			
Dependent Variable : STAY_MSR, Number of Observations : 12,363			
<i>Independent Variables</i>	<i>Coefficients</i>	<i>Standard Errors</i>	<i>Prob > Chi-squared</i>
COMAGE	0.0106561	0.00123	0***
FEMALE	-0.0266267	0.00636	0***
SINGLE	-0.0132476	0.00569	0.02**
BLACK	0.0285204	0.0064	0***
OTHERRACE	0.003228	0.0262	0.902
LESSTHANBD	0.0069348	0.0253	0.784
MASTERORABOVE	0.1375454	0.00595	0***
DEP_2	0.0455202	0.00515	0***
DEP_3	0.0705605	0.00528	0***
DEP_4	0.0896994	0.00504	0***
ROTC_SCH	-0.0553715	0.00773	0***
ROTC_NON_SCH	-0.0560547	0.01066	0***
OTSANDOTHER	-0.0342118	0.01053	0.001***
LOG	-0.0220289	0.0099	0.026**
SUP	-0.0695823	0.00779	0***
ACQ	-0.1028133	0.00955	0***
SPD	-0.1024389	0.03929	0.009***
<i>Predicted Probability for the Base Case = .909</i>			
* significant at 10%; ** significant at 5%; *** significant at 1%			

Table 17. Marginal Effects of the Independent Variables for the MSR Retention Model

Among the demographic variables, only the OTHERRACE had a statistically insignificant marginal effect. An officer with exactly the same characteristics as the base case, except the sex is female, has a 2.66 percentage points lower probability of staying in the Air Force after the obligated service. A black officer has a 2.85 percentage points greater probability of staying than a white officer. Officers with two, three and four or more dependent counts are 4.55, 7.05 and 8.97 percentage points more likely to stay in the service in relation to the base case, respectively. The coefficient of the COMAGE variable indicates that a 1-year increase at the commissioning age is associated with a 1.06 percentage point higher probability of staying in comparison to an officer of mean age.

The LESSTHANBD variable that represents officers with less than Baccalaureate degrees was insignificant. All other variables that represent the professional and

educational background of the officers were statistically significant at 1 percent, except LOG, at 5 percent. Holding other characteristics fixed with the comparison officer, an officer with Master's or above degree has 13.75 percent higher probability of staying compared to the base officer. Officers commissioned through ROTC scholarship program, ROTC non-scholarship program, OTS and other sources have a decreased probability of staying of 5.53, 5.60 and 3.42 with respect to officers commissioned through USAFA. Officers from the Logistics, Support, Acquisition and Special Duty career fields have a lower probability of staying after MSR, at 2.2, 6.96, 10.28 and 10.24 percent as compared to the officers from the Operations career field.

C. RETENTION TO THE O-4 PROMOTION BOARD MODEL

The second retention model analyzes the effect of commissioning source on retention to O-4 promotion board. The data sample used for the analysis includes 9,351 Air Force Line officers, 7,313 of whom stayed in the military long enough to appear on the O-4 promotion board (at least 9 years according to Air Force Pamphlet 36-2506), while 2,038 officers voluntarily left the military before the 9-year service point. The overall retention rate for the sample is 78.21 percent. Table 18 displays the likelihood ratio statistic and p-value for the overall model, coefficients (maximum likelihood estimates), standard errors and significance levels for the independent variables.

Retention to the O-4 Promotion Board Model		
Dependent Variable: STAY_O4, Number of Observations: 9,342		
<i>Independent Variables</i>	<i>Coefficients</i>	<i>Standard Errors</i>
COMAGE	0.1446	(0.0177)***
FEMALE	-0.2516	(0.0797)***
SINGLE	-0.3233	(0.0727)***
BLACK	0.5026	(0.1191)***
LESSTHANBD	-1.4753	(0.5118)***
MASTERORABOVE	1.5486	(0.0654)***

Retention to the O-4 Promotion Board Model		
Dependent Variable: STAY_O4, Number of Observations: 9,342		
<i>Independent Variables</i>	<i>Coefficients</i>	<i>Standard Errors</i>
DEP_2	0.6321	(0.0848)***
DEP_3	1.2669	(0.0923)***
DEP_4	1.7972	(0.1284)***
ROTC_SCH	-0.2788	(0.0755)***
ROTC_NON_SCH	-0.4854	(0.0932)***
OTSANDOTHER	-0.3842	(0.1162)***
LOG	-1.0942	(0.1112)***
SUP	-1.5206	(0.0792)***
ACQ	-1.9752	(0.0821)***
SPD	-2.0230	(0.2600)***
Intercept	-2.1462	(0.3954)***
<i>Likelihood Ratio Statistic = 2385.33, Degrees of Freedom = 16, p-value = 0.0000</i>		
<i>Pseudo R-squared = 0.2434</i>		
Standard errors are displayed in parentheses		
* significant at 10%; ** significant at 5%; *** significant at 1%		

Table 18. Results for the Retention to the 0-4 Promotion Board Model

Goodness-of-fit measures used to test the retention model are the likelihood-ratio (LR) test and the Pseudo R-squared value. The likelihood ratio statistic is 2,385.33 with 16 degrees of freedom and $\text{prob} > \chi^2 = 0$. The null hypothesis (H_0) in a LR test indicates that the coefficients of the all independent variables are zero and therefore they have no effect on the dependent variable. According to the likelihood ratio statistic it is possible to reject the null hypothesis and accept that at least one of the explanatory variables affects the dependent variable, STAY_O4. The Pseudo R-squared is equal to 0.2434, which is higher than the previous retention model. It is computed in a way that is comparable to the usual R-squared from OLS estimation of a linear probability model that shows the percentage of variation in the dependent variable explained by the independent (Wooldridge, 2009, pp. 575–586). The explanatory power of the model may be improved by including more variables to the model. However, as stated in the first retention model, the research question of the study is to find out the relationship between

commissioning source and officer performance and, therefore, obtaining reliable estimates about the research issue is more important.

1. Interpretation of the Coefficients

According to Table 18, all of the estimates were statistically significant. The effects of the demographics variables are consistent with the MSR retention model. Female, single and white officers were found less likely to stay to the O-4 promotion board in comparison to male, married and black officers, respectively. Unlike the MSR retention model, this model does not include officers who were from OTHERRACE race category since the retention rate was 100 percent for this category. Officers with more than one dependent were found to be more likely to stay to the O-4 promotion board as compared to officers with one or no dependent. The coefficient of the COMAGE variable indicates that higher age at commissioning is associated with a higher probability of staying to the targeted career point.

Regarding the professional and educational backgrounds variables, the findings are the same as in the previous retention model. Probability of staying to the O-4 promotion board was higher for officers with advanced educational degrees, as compared to officers who had Baccalaureate degrees, whereas it was lower for officers who had less than Baccalaureate degrees. The coefficients of the commissioning source variables indicate that graduates of ROTC programs, and OTS and other sources are less likely to stay to the O-4 promotion board than USAFA graduates. Officers from the Support, Logistics, Acquisition and Special Duty career fields have a lower probability of staying than officers from the Operations career field. The results are consistent with the hypothesized effects of the variables except for the OTSANDOTHER categorical independent variable, which were expected to have a higher probability of staying than USAFA graduates. As noted for the results of the MSR retention model, more military training and education received by USAFA graduates may offset the experience advantage of OTS graduates, most of whom are prior enlisted service members.

2. Marginal Effects of the Independent Variables

The marginal effects of the coefficients are interpreted with respect to a "baseline" person. In the O-4 retention model, the "baseline" person is an officer who is at average age of 24.04, male, married and white, with no or one dependent, with a Baccalaureate degree, commissioned through USAFA and in the Operations career field. According to Table 19, the comparison officer has a probability of staying to the O-4 promotion Board of 85.65 percent.

Marginal Effects for the Retention to O-4 Promotion Board Model			
Dependent Variable: STAY_O4, Number of Observations: 9,342			
<i>Independent Variables</i>	<i>Coefficients</i>	<i>Standard Errors</i>	<i>Prob > Chi-squared</i>
COMAGE	0.0177789	0.00216	0***
FEMALE	-0.0330534	0.01117	0.003***
SINGLE	-0.0425582	0.01026	0***
BLACK	0.0527428	0.01052	0***
LESSTHANBD	-0.2789279	0.12472	0.025**
MASTERORABOVE	0.202899	0.00884	0***
DEP_2	0.067243	0.00784	0***
DEP_3	0.1266271	0.00756	0***
DEP_4	0.1476289	0.00681	0***
ROTC_SCH	-0.0354764	0.00994	0***
ROTC_NON_SCH	-0.0662988	0.01403	0***
OTSANDOTHER	-0.0510717	0.01662	0.002***
LOG	-0.1811449	0.02283	0***
SUP	-0.2507041	0.01562	0***
ACQ	-0.353217	0.01713	0***
SPD	-0.4128476	0.06363	0***
<i>Predicted Probability for the Base Case = .856</i>			
* significant at 10%; ** significant at 5%; *** significant at 1%			

Table 19. Marginal Effects for the Retention to O-4 Model

Similar to the MSR retention model, the coefficients of the demographic variables were statistically significant at the 1 percent level. Being female or being single decreases the probability of staying to the O-4 promotion board by 3.3 and 4.25 percentage points respectively, while being black increases the probability by 5.27 percentage points. Officers with two, three and four or more dependents are 6.72, 12.66 and 14.76

percentage points more likely to stay in the service in comparison to the base person, respectively. A 1-year increase in the commissioning age will result in a 1.78 percentage points higher probability of staying to the targeted retention point with respect to an officer of mean age. Although direction of the effects remains the same in both retention models, the magnitudes of the marginal effects are slightly higher in the second retention model.

The coefficients of the professional and educational background variables were statistically significant. For those with a Baccalaureate degree, and those with a Master's or above degree, the probability of staying to the O-4 promotion board increases by 27.8 or 20.3 percentage points, respectively. The results suggest that officers commissioned through the ROTC scholarship program, ROTC non-scholarship program, and OTS and other sources are less likely to stay to the targeted retention point by 3.54, 6.62 and 5.1 percentage points compared to officers commissioned through USAFA, respectively. Officers from the Logistics, Support, Acquisition, and Special Duty career fields have a lower probability of staying of 18.11, 25.07, 35.32 and 41.3 percentage points, respectively, when compared to officers from the Operations career field.

When compared to the first retention model, the absolute magnitudes of the coefficients are similar for the commissioning source categories whereas they are greater for the career field categories. This may indicate that the difference in retention between USAFA and other sources remains similar over time whereas the difference increases between Operations and other career fields. The huge difference between the Operations and Special Duty (SD) career fields may be due to the small sample size of the SD category since officers from this category constitute only 1 percent of the samples used in retention models.

D. O-4 PROMOTION MODEL

The promotion model examines the effect of commissioning source on promotion to Major by using the same data sample created for the second retention model after excluding the leavers. According to data analysis, 5,423 out of 7,313 Air Force Line officers promoted to the grade of O-4, for a promotion rate of 74.16 percent. The

likelihood ratio statistic and p-value for the overall model, coefficients, standard errors and significance levels are presented in Table 20.

The O-4 Promotion Model			
Dependent Variable: PROMOTED_O4, Number of Observations: 7,313			
<i>Independent Variables</i>	<i>Coefficients</i>	<i>Standard Errors</i>	<i>P > z </i>
COMAGE	-0.00232	(0.0154)	0.881
FEMALE	-0.14968	(0.0936)	0.11
SINGLE	0.102135	(0.0866)	0.238
BLACK	-0.21911	(0.1133)*	0.053
OTHERRACE	-0.14395	(0.7325)	0.844
LESSTHANBD	-0.553002	(0.7747)	0.475
MASTERORABOVE	1.040273	(0.0596)***	0.04
DEP_2	0.205077	(0.0847)**	0.016
DEP_3	0.455321	(0.0811)***	0.000
DEP_4	0.695019	(0.0945)***	0.000
ROTC_NON_SCH	0.193143	(0.0885)**	0.029
ROTC_SCH	-0.19629	(0.0712)***	0.006
OTSANDOTHER	0.717998	(0.1178)***	0.000
LOG	-0.2158	(0.1101)*	0.05
SUP	-0.07362	(0.0844)	0.383
ACQ	-0.26386	(0.0870)***	0.002
SPD	-0.18795	(0.3356)	0.575
Intercept	-0.2298352	(0.3469357)	0.702
<i>Likelihood Ratio Statistic = 641.99, Degrees of Freedom = 17, p-value = 0.0000</i>			
<i>Pseudo R-squared = 0.0768</i>			
Standard errors are displayed in parentheses			
* significant at 10%; ** significant at 5%; *** significant at 1%			

Table 20. Results for the O-4 Promotion Model

The likelihood-ratio (LR) test and Pseudo R-squared value of the model were used to test the goodness-of-fit of the O-4 promotion model. Since the likelihood ratio statistic is 641.99 with 17 degrees of freedom and p-value > chi-squared = 0, it is possible to reject the null hypothesis and accept that at least one of the explanatory variables has relationship with the dependent variable, PROMOTED_O4. The Pseudo R-squared is 0.0768. As noted before, the R-squared of a logit model is calculated in an algebraically equivalent way with the usual R-squared of an OLS linear probability model that indicates the percentage of variation in the dependent variable explained by the

independent variables (Wooldridge, 2009, pp. 575–586). Although the promotion model has a lower explanatory power with respect to previous models, the overall model still has a statistically significant relationship with the dependent variable. Also, one of the goals of the study is to analyze the effect of commissioning sources on promotion to major, and all of the commission program dummies are statistically significant.

1. Interpretation of the Coefficients

The coefficient of the BLACK variable was statistically significant at 10 percent with a negative sign, which indicates that African American officers are less likely to promote to the grade of O-4 compared to white officers. This was surprising since they were found to be more likely to stay to O-4 promotion board. All three variables for number of dependents were statistically significant. Therefore, the author concludes that officers with more than one dependent have a higher probability of promotion to O-4 compared to officers who have one or no dependent, which is consistent with the hypothesized effects of these variables. The rest of the demographic independent variables were statistically insignificant, which may indicate that personal characteristics of an officer are not as important for promotion as the professional and educational background factors.

The coefficients of all of the professional and educational background variables were statistically significant, except for LESSTHANBD, SUP and SPD. The LESSTHANBD educational level variable represents officers who had less than a Bachelor's degree. However, the small sample of such officers (7 officers-only 0.1 percent of the data sample) may account for the insignificant result. Officers with Master's and above degrees were more likely to promote to O-4 in comparison to officers with a Bachelor's degree, as was expected. Advanced educational degrees may have made them more competitive regarding career progression compared to their colleagues with Bachelor's degrees.

All commissioning source variables have positive signs except the ROTC_SCH. The coefficients indicate that graduates of the ROTC_NON_SCH program, OTS and other sources are more likely to promote to major than USAFA graduates, whereas

officers commissioned through ROTC_SCH programs have a lower probability of promotion. ROTC_NON_SCH program graduates were expected to be less likely to be promoted than USAFA graduates who receive relatively longer military training and education. However, overall results are consistent with the findings of the preliminary data analysis, which revealed 7 and 15 percent higher promotion rates for officers commissioned from ROTC_NON_SCH and OTSANDOTHER commissioning source categories compared to USAFA graduates.

Officers from the Logistics and Acquisition career fields were less likely to be promoted to Major than officers from the Operations career field. There may be more career opportunities for officers from the Operations specialty in comparison to those in other career branches. The results are consistent with the hypothesized effects.

2. Marginal Effects of the Independent Variables

The "baseline" person is an officer who is 24.23, male, married and white, with no or one dependent, with a Baccalaureate degree, commissioned through USAFA and in the Operations career field. Table 21 indicates that the comparison officer has a probability of promotion to major of 76.34 percent.

Marginal Effects for the O-4 Promotion Model			
Dependent Variable: PROMOTED_O4, Number of Observations: 7,313			
<i>Independent Variables</i>	<i>Coefficients</i>	<i>Standard Errors</i>	<i>Prob > Chi-squared</i>
COMAGE	-0.0004187	0.00279	0.881
FEMALE	-0.0278774	0.01794	0.12
SINGLE	0.0181009	0.01506	0.229
BLACK	-0.0415459	0.02247	0.064*
OTHERRACE	-0.0269745	0.14217	0.85
LESSTHANBD	-0.1135206	0.17622	0.519
MASTERORABOVE	0.1974641	0.01148	0.000***
DEP_2	0.0357693	0.01425	0.012**
DEP_3	0.0781609	0.01317	0.000***
DEP_4	0.1115877	0.01327	0.000***
ROTC_NON_SCH	0.033792	0.01498	0.024**
ROTC_SCH	-0.0361519	0.01336	0.007**
OTSANDOTHER	0.1163515	0.01684	0.000***
LOG	-0.0408119	0.02174	0.06*
SUP	-0.0134621	0.01563	0.389
ACQ	-0.0499478	0.01719	0.004***

SPD	-0.0355821	0.0664	0.592
<i>Predicted Probability for the Base Case = .763</i>			
* significant at 10%; ** significant at 5%; *** significant at 1%			

Table 21. Marginal Effects for the Promotion to O-4 Model

The estimated coefficient of BLACK was statistically significant at the 10 percent level. Therefore, we can conclude that black officers (holding other characteristics fixed) are 4.15 percentage points less likely to promote to major in relation to the baseline (white) officer. The variables for number of dependents, DEP_2, DEP_3 and DEP_4 have statistically significant effects of 5, 1 and 1 percent on promotion, respectively. The coefficients indicate that officers who have the same exact characteristics as the base officer but have two, three or four or more dependents are 3.58, 7.82 and 11.16 percentage points more likely to promote to O-4 than the baseline person, respectively.

The coefficient of the MASTERANDABOVE variable was statistically significant at the 1 percent level. The marginal effect of this variable shows that getting a M.A degree increases the probability of promotion to major by 19.75 percent. Since the estimates were statistically significant for the ROTC_NON_SCH and OTSANDOTHER commissioning source variables at 5 and 1 percent, it can be concluded that ROTC non-scholarship program and OTS/other graduates have a 3.38 and 11.63 percentage points higher probability of promotion to major compared to USAFA graduates. However, an ROTC scholarship commission decreases the promotion probability by 3.61 percentage points. In regard to the career field variables, officers from the Logistics and Acquisition career fields had 4.08 and 5 percentage points lower promotion probabilities to O-4 in comparison to an officer in the Operations career field.

E. THE ROBUSTNESS OF THE RESULTS

There are three main issues that may decrease the robustness of the results: Non-random sampling bias, omitted variable bias and heteroskedasticity. Although the first two problems cause estimates to be biased and inconsistent, heteroskedasticity does not cause bias or inconsistency in the estimators. However, it may decrease the efficiency of estimators (Wooldridge, 2009, pp. 68–105).

Non-random sampling causes the coefficients to be biased and inconsistent. Missing data for an observation on either the dependent or one of the explanatory variables and sample selection based on the dependent variable may result in a non-random sample. If the data are missing at random, then this does not violate the random sampling assumption and only means a smaller sample size. Including a dummy for missing observations is one solution for this problem. However, if the data are not missing at random, then the estimates are biased (Wooldridge, 2009, pp. 322-325). For example, in a survey of high school students, if income is missing for individuals who have low family incomes because they refuse to answer the wealth question (they may be embarrassed), then this situation may cause non-random sampling. Another non-random sampling problem, sample selection bias occurs when the sample is based on whether the dependent variable is below or above a given value. For example, if only individuals who earn more than a \$7,000 annual salary are chosen when analyzing the effect of several independent variables on the monthly income dependent variable, then sample selection bias occurs, because including individuals of lower income levels may result in different estimates. Since missing observations were dropped from the created data samples, the author can conclude that there is no non-random sampling bias.

If an omitted independent variable is correlated with an independent variable included in a model, then the estimates of the observed variables will be biased. However, generally the focus is on the relationship between a particular independent variable (in this study, the education level variable) and the omitted factor (innate learning ability). Fortunately, if all other independent variables are uncorrelated with the focus variable, the education level, then ignoring the possible bias caused by the omitted ability factor on those other variables is a valid practice (Wooldridge, 2009, pp. 89–94). Since the correlations between education level and other explanatory variables included in the logit models of this study are ignorable, the effect of bias can be restricted to the estimate of the education level variable. There is a positive correlation between education level and learning ability, and ability may have a positive effect on overall job performance. Therefore, some of the positive effect caused by an omitted ability variable may be captured by the education level variables, which causes their estimates to be

larger than expected. However, according to the findings of a careful study about estimating the returns to education using a sample of identical twins, the failure to control for ability imparts only a small upward bias to the usual estimates of the rate of return to schooling (Ashenfelter & Rouse, 1998).

The homoskedasticity assumption states that the variance of the unobservable error term, conditional on the independent variables, is constant. Violation of this assumption does not cause inconsistent or biased estimators. As noted previously, it only may decrease the robustness of the coefficients. Fortunately, testing for heteroskedasticity is possible and there are corrective measures that can be taken in case of a heteroskedasticity (Wooldridge, 2009, pp. 264–275). It is easy to obtain robust standard errors using the robust option of standard regression with the software package utilized in this study, STATA 10.1. The Appendix includes logistic regression results and OLS regression results with robust standard errors for retention and promotion models. When the results of the logistic regression models used in the study were compared to the results of linear regressions with robust standard errors, it was found that the signs of the estimates remained the same. Moreover, there were only small differences in magnitude among the estimates. The main exception was the estimate of the Special Duty variable in the retention to the O-4 promotion board model, which decreased from 41 percent to 28 percent. However, the ranking among the career field categorical variables remained the same. Therefore, the author can conclude that the findings of this study are efficient in terms of heteroskedasticity.

Moreover, the study only includes officers who left the service voluntarily (as reported by the Interservice Separation Codes). Officers who had been separated involuntarily with separation codes such as poor health conditions, death and unknown were excluded from the samples. This also improves the robustness of the study in terms of analyzing voluntary retention behavior.

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V. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

A. SUMMARY

The primary purpose of this study was to investigate the effect of commissioning programs on career progression for U.S. Air Force Line officers. Some proxy measures were used to measure officer job performance, and to compare the average performance of officers from each commissioning program. This study constructed three logistic regression models to analyze the relationship between commissioning source and officer performance using retention and promotion to O-4 as performance measures. Two measures of retention were used: the retention after minimum service requirement (MSR), and retention to the O-4 promotion board (STAY_O4) model.

The original data used in the models was taken from the Defense Manpower Data Center (DMDC), which was developed from the Active Duty Military Master File (ADMMF) and the Separation File (SF) for the Air Force Officers. The ADMMF contains information about demographics, professional and educational background, whereas the SF includes reasons and dates of leaving for the Air Force officers who were commissioned between 1992 and 2006.

The data set used to analyze MSR retention included 12,361 Air Force Line officers (excluding officers from the Pilot career field) commissioned between 1992 and 2000, while there were 9,351 officers commissioned between 1992 and 1997 in the STAY_O4 data set. The overall retention rates were 85 and 78 percent, respectively. Preliminary data analysis revealed that officers from Officer Training School (OTS) and the U.S. Air Force Academy (USAFA) had higher retention rates than officers commissioned through the Reserve Officer Training Corps (ROTC) programs. In regard to the promotion data sample, there were 7,313 officers and the overall promotion rate was 74 percent. OTS and ROTC non-scholarship program graduates had higher promotion rates than USAFA and ROTC scholarship program graduates.

B. CONCLUSIONS

The first retention model analyzed the effect of commissioning sources on retention after minimum service requirement. The commissioning source variables were found to be statistically significant at the 1 percent level. According to the results, the USAFA graduates are more likely to stay in the Air Force after completing the initial active duty service commitment than officers commissioned from other sources. The graduates of other commissioning sources can be listed from the highest probability of staying to the lowest, compared to USAFA graduates, as follows: OTS and other sources, ROTC non-scholarship program and ROTC scholarship program. Similarly, analysis of the retention to the O-4 promotion board model revealed that USAFA graduates had a higher probability of staying than graduates of other accession programs.

In both retention models, most of the other explanatory variables were found to be statistically significant. The findings of demographic variables suggest that female, single and white officers are less likely to stay than male, married and Black officers, respectively. Additionally, officers with more than one dependent and officers who were older at commissioning were found to be more likely to stay compared to officers with no or one dependent and officers who were younger at commissioning. Among the independent variables that represent professional and educational background of individuals, officers with Master's or above degrees were found to be more likely to stay than officers with Baccalaureate degrees. This result suggests that advanced education increases the probability of retention. All career field variables were statistically significant in both retention models. According to the results, officers from the Operations career field are more likely to stay in the Air Force than officers from the Logistics, Support, Acquisition and Special Duty career fields.

The promotion model results indicate statistically significant effects of commissioning source on promotion to Major. Although USAFA graduates were found to be more likely to stay to the O-4 promotion board than other officers, they had lower probability of promotion to O-4 than ROTC non-scholarship program and OTS graduates. According to the findings, officers commissioned through OTS have the

highest probability of promotion. In terms of the effect of other independent variables, having more than one dependent has a positive effect on promotion whereas being an African American seems to have a negative effect. The findings also suggest that possessing postgraduate degrees increases the promotion probability, while being from the Logistics or Acquisition career fields decreases the probability.

The analysis of all three logistic regression models shows that commissioning source is a significant determinant of retention and promotion in the Air Force. Commissioning through USAFA increases the probability of staying in the Air Force. USAFA graduates attend the Academy at a relatively young age in order to be Air Force officers, which may be a sign of higher taste for the military. They also receive the longest military education and training in comparison to graduates of other commissioning sources, which makes them more equipped to be successful in the service. Having these features seems to increase the probability of seeking career opportunities inside the Air Force rather than the civilian sector for USAFA graduates. Although USAFA graduates were initially expected to have higher promotion rates, the results suggest that they are less likely to promote to the grade of O-4 than officers commissioned through OTS and the ROTC Non-Scholarship program. However, they have a higher probability of promotion than officers from ROTC scholarship program.

C. RECOMMENDATIONS

According to the findings of this thesis, if retention and promotion are accepted as adequate job performance measures, USAFA and OTS graduates seem to perform better than officers commissioned through ROTC programs. Currently, almost half of new active component officers are commissioned through ROTC programs (Population Representation in Military Services, 2009). Hence, The Air Force should consider increasing the mix of officers commissioned through USAFA and OTS. However, a cost-effectiveness analysis should be performed by using “marginal cost of producing one additional officer of each accession source” as a comparison factor to fully analyze the optimum officer mix. Additionally, since officers with Master’s (or above) degrees have a greater probability of retention and promotion, it may be that acquiring an advanced

degree may boost the retention and promotion prospects of groups with otherwise lower rates of retention and promotion (such as female, single, Logistics, Support, Acquisition and Special Duty career fields).

Due to the lack of required data elements, some variables such as “prior enlisted status,” “fitness reports,” “officer evaluation reports,” “performance at branch schools” and “graduate GPA” could not be included in this study. In future research, controlling for these explanatory variables may improve the robustness of the results. Since the effects of commissioning source on retention and promotion to the grade of O-5 could not be analyzed in this research, a follow-on study could focus on the effects of commissioning sources on retention and promotion to Lieutenant Colonel to find out whether signs and magnitudes of the effects remain the same.

APPENDIX

A. MSR RETENTION MODEL

Logistic regression	Number of obs	=	12361
	LR chi2(17)	=	1925.90
	Prob > chi2	=	0.0000
Log likelihood = -4228.8206	Pseudo R2	=	0.1855

STAY_MSR	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
COMAGE	.1292031	.0151393	8.53	0.000	.0995305 .1588757
FEMALE	-.2980551	.0658029	-4.53	0.000	-.4270263 -.1690838
SINGLE	-.1553529	.0644178	-2.41	0.016	-.2816094 -.0290964
BLACK	.3944202	.1013589	3.89	0.000	.1957604 .59308
OTHERRACE	.0397734	.03280687	0.12	0.904	-.6032294 .6827762
LESSTHANBD	.0871049	.3293563	0.26	0.791	-.5584215 .7326313
MASTERORAB-E	1.585275	.0663912	23.88	0.000	1.455151 1.7154
DEP_2	.6553571	.0870224	7.53	0.000	.4847962 .825918
DEP_3	1.070681	.0991897	10.79	0.000	.8762731 1.26509
DEP_4	1.686171	.155882	10.82	0.000	1.380648 1.991694
ROTC_SCH	-.6162022	.0785926	-7.84	0.000	-.7702409 -.4621634
ROTC_NON_SCH	-.5814962	.0957207	-6.07	0.000	-.7691054 -.393887
OTSANDOTHER	-.3883342	.1118239	-3.47	0.001	-.607505 -.1691633
LOG	-.2470081	.102869	-2.40	0.016	-.4486276 -.0453886
SUP	-.7323435	.0714851	-10.24	0.000	-.8724517 -.5922353
ACQ	-.9941002	.076033	-13.07	0.000	-1.143122 -.8450782
SPD	-.8799333	.2545051	-3.46	0.001	-1.378754 -.3811123
_cons	-1.31436	.3448991	-3.81	0.000	-1.99035 -.6383701

Marginal effects after logit
 $y = \text{Pr}(\text{STAY_MSR})$ (predict)
 $= .90929785$

variabl e	dy/dx	Std. Err.	z	P> z	[95% C. I.]	X
COMAGE	.0106561	.00123	8.64	0.000	.008238	.013074	24.751	
FEMALE*	-.0266267	.00636	-4.18	0.000	-.030909	-.014154	.176361	
SINGLE*	-.0132476	.00569	-2.33	0.020	-.024398	-.002097	.240353	
BLACK*	.0285204	.0064	4.46	0.000	.015979	.041062	.087695	
OTHER-E*	.003228	.0262	0.12	0.902	-.04812	.054576	.006067	
LESSTH-D*	.0069348	.0253	0.27	0.784	-.042646	.056515	.004692	
MASTER-E*	.1375454	.00595	23.12	0.000	.125883	.149207	.501011	
DEP_2*	.0455202	.00515	8.84	0.000	.035424	.055616	.1673	
DEP_3*	.0705605	.00528	13.36	0.000	.060206	.080915	.219157	
DEP_4*	.0896994	.00504	17.81	0.000	.079827	.099571	.143192	
ROTC_SCH*	-.0553715	.00773	-7.16	0.000	-.070523	-.04022	.342853	
ROTC_N-H*	-.0560547	.01066	-5.26	0.000	-.076951	-.035158	.178384	
OTSAND-R*	-.0342118	.01053	-3.25	0.001	-.054843	-.01358	.300218	
LOG*	-.0220289	.0099	-2.23	0.026	-.041428	-.00263	.115363	
SUP*	-.0695823	.00779	-8.94	0.000	-.084842	-.054323	.276029	
ACQ*	-.1028133	.00395	-10.76	0.000	-.121536	-.084091	.233234	
SPD*	-.1024389	.03929	-2.61	0.009	-.17945	-.025428	.011002	

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Figure 2. MSR Logit Retention Model Results

Linear regression

Number of obs = 12361
 F(17, 12343) = 101.80
 Prob > F = 0.0000
 R-squared = 0.1393
 Root MSE = .3301

STAY_MSR	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
COMAGE	.0106691	.0010483	10.18	0.000	.0086143	.0127238
FEMALE	-.0384345	.0095801	-4.01	0.000	-.0572129	-.0196561
SINGLE	-.0290279	.0100214	-2.90	0.004	-.0486714	-.0093844
BLACK	.0426738	.0106166	4.02	0.000	.0218636	.063484
OTHERRACE	.0156135	.0428084	0.36	0.715	-.0682977	.0995248
LESSTHANBD	.0110181	.0543417	0.20	0.839	-.0955002	.1175365
MASTERORAB-E	.162629	.0061379	26.50	0.000	.1505978	.1746603
DEP_2	.0854535	.0093578	9.13	0.000	.0671107	.1037963
DEP_3	.1055205	.0083839	12.59	0.000	.0890869	.1219542
DEP_4	.1230386	.0082455	14.92	0.000	.1068762	.1392011
ROTC_SCH	-.074851	.0092652	-8.08	0.000	-.0930123	-.0566898
ROTC_NON_SCH	-.0615057	.0105847	-5.81	0.000	-.0822534	-.040758
OTSANDOTHER	-.0438534	.0109884	-3.99	0.000	-.0653923	-.0223144
LOG	-.0279504	.0093842	-2.98	0.003	-.0463448	-.0095559
SUP	-.0803118	.0077694	-10.34	0.000	-.095541	-.0650826
ACQ	-.1030292	.0083084	-12.40	0.000	-.119315	-.0867433
SPD	-.0915067	.0293637	-3.12	0.002	-.1490643	-.0339492
_cons	.5610565	.0251024	22.35	0.000	.5118518	.6102611

Figure 3. MSR Linear Probability Model Regression Results with Robust Standard Errors

B. THE RETENTION TO O-4 PROMOTION BOARD MODEL

Logistic regression

Number of obs = 9342

LR chi 2(16) = 2385.33

Prob > chi 2	=	0.0000
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Pseudo R2 = 0.2434

Log likelihood = -3707.7964

STAY_04	Coeff.	Std. Err.	z	P> z	[95% Conf. Interval]
COMAGE	.1446381	.0176585	8.19	0.000	.1100281 .179248
FEMALE	-.2515888	.0796584	-3.16	0.002	-.4077164 -.0954613
SI_NGLE	-.3232877	.0727381	-4.44	0.000	-.4658518 -.1807236
BLACK	.5025542	.1190731	4.22	0.000	.2691751 .7359333
LESSTHANBD	-1.475284	.5118419	-2.88	0.004	-2.478476 -.4720922
MASTERORAB-E	1.548624	.0653826	23.69	0.000	1.420476 1.676771
DEP_2	.6321101	.0847565	7.46	0.000	.4659905 .7982297
DEP_3	1.266895	.0923009	13.73	0.000	1.085988 1.447801
DEP_4	1.7972	.1284033	14.00	0.000	1.545535 2.048866
ROTC_NON_SCH	-.4853538	.0931865	-5.21	0.000	-.667996 -.3027115
ROTC_SCH	-.2788249	.0754739	-3.69	0.000	-.426751 -.1308988
OTSANDOTHER	-.3842402	.1161986	-3.31	0.001	-.6119852 -.1564952
LOG	-1.094207	.1111643	-9.84	0.000	-1.312085 -.8763292
SUP	-1.5206	.0791645	-19.21	0.000	-1.67576 -1.365441
ACQ	-1.975206	.0821292	-24.05	0.000	-2.136176 -1.814236
SPD	-2.022989	.2599867	-7.78	0.000	-2.532554 -1.513425
_cons	-2.146218	.3954487	-5.43	0.000	-2.921283 -1.371152

Marginal effects after logit

$$y = \text{Pr}(\text{STAY_04}) \text{ (predict)}$$
$$= .85648309$$

variable	dy/dx	Std. Err.	z	P> z	[95% C.I.]	X
COMAGE	.0177789	.00216	8.24	0.000	.013549	.022008	24.0425	
FEMALE*	-.0330534	.01117	-2.96	0.003	-.054937	-.01117	.125883	
SINGLE*	-.0425582	.01026	-4.15	0.000	-.062669	-.022448	.201456	
BLACK*	.0527428	.01052	5.01	0.000	.032116	.073369	.063691	
LESSTH-D*	-.2789279	.12472	-2.24	0.025	-.523376	-.03448	.002248	
MASTER-E*	.202899	.00884	22.96	0.000	.185576	.220222	.539927	
DEP_2*	.067243	.00784	8.58	0.000	.051874	.082612	.176836	
DEP_3*	.1266271	.00756	16.75	0.000	.111814	.14144	.254014	
DEP_4*	.1476289	.00681	21.68	0.000	.134285	.160973	.163562	
ROTC_N-H*	-.0662988	.01403	-4.73	0.000	-.09379	-.038808	.191929	
ROTC_SCH*	-.0354764	.00994	-3.57	0.000	-.054951	-.016002	.328838	
OTSAND-R*	-.0510717	.01662	-3.07	0.002	-.08365	-.018494	.213552	
LOG*	-.1811449	.02283	-7.94	0.000	-.225885	-.136405	.081353	
SUP*	-.2507041	.01562	-16.05	0.000	-.281314	-.220094	.202633	
ACQ*	-.353217	.01713	-20.62	0.000	-.386784	-.31965	.180368	
SPD*	-.4128476	.06363	-6.49	0.000	-.537567	-.288128	.009955	

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Figure 4. STAY_O4 Logit Retention Model Results

Linear regression

Number of obs = 9351
 F(17, 9333) = 162.86
 Prob > F = 0.0000
 R-squared = 0.2313
 Root MSE = .36231

STAY_O4	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
COMAGE	.0169564	.0017924	9.46	0.000	.013443	.0204699
FEMALE	-.044786	.0140321	-3.19	0.001	-.0722919	-.0172801
SINGLE	-.0664115	.0133446	-4.98	0.000	-.0925698	-.0402532
BLACK	.0591941	.0166365	3.56	0.000	.0265829	.0918053
OTERRACE	.1887741	.0303633	6.22	0.000	.1292555	.2482927
LESSTHANBD	-.2891892	.0959171	-3.01	0.003	-.4772077	-.1011708
MASTERORAB-E	.2033407	.0080711	25.19	0.000	.1875197	.2191617
DEP_2	.1120132	.0126847	8.83	0.000	.0871484	.136878
DEP_3	.1688851	.0112246	15.05	0.000	.1468824	.1908877
DEP_4	.2017515	.0114537	17.61	0.000	.1792998	.2242033
ROTC_NON_SCH	-.0648204	.0115991	-5.59	0.000	-.0875572	-.0420836
ROTC_SCH	-.0398401	.0102017	-3.91	0.000	-.0598377	-.0198426
OTSANDOTHER	-.0465415	.0148516	-3.13	0.002	-.0756539	-.0174291
LOG	-.1384123	.0144638	-9.57	0.000	-.1667645	-.11006
SUP	-.2040381	.01106	-18.45	0.000	-.2257181	-.1823582
ACQ	-.2667713	.0114098	-23.38	0.000	-.289137	-.2444056
SPD	-.2854431	.0426366	-6.69	0.000	-.3690202	-.201866
_cons	.3236162	.0404637	8.00	0.000	.2442985	.4029339

Figure 5. STAY_O4 Linear Probability Model Regression Results with Robust Standard Errors

C. THE PROMOTION TO O-4 MODEL

Logistic regression

Number of obs = 7313

LR chi 2(17) = 641.99

Prob > chi 2	=	0.0000
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Pseudo R2 = 0.0768

Log likelihood = -3857.8214

PROMOTED_04	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
COMAGE	-.0023181	.0154374	-0.15	0.881	-.0325749 .0279387
FEMALE	-.1496808	.0935823	-1.60	0.110	-.3330988 .0337371
SINGLE	.1021346	.0866253	1.18	0.238	-.067648 .2719711
BLACK	-.2191059	.1132557	-1.93	0.053	-.441083 .0028712
OTHERRACE	-.143948	.1732533	-0.20	0.844	-1.579686 1.29179
LESSTHANBD	-.5530017	.7746763	-0.71	0.475	-2.071339 .9653359
MASTERORAB-E	1.040273	.0596419	17.44	0.000	.9233769 1.157169
DEP_2	.2050774	.0847283	2.42	0.016	.039013 .3711418
DEP_3	.455321	.0810602	5.62	0.000	.2964458 .6141961
DEP_4	.6950185	.0945379	7.35	0.000	.5097277 .8803093
ROTC_NON_SCH	.1931434	.0885525	2.18	0.029	.0195837 .3667031
ROTC_SCH	-.1962895	.0711797	-2.76	0.006	-.335799 -.0567799
OTSANDOTHER	.7179983	.1177808	6.10	0.000	.4871523 .9488443
LOG	-.2158017	.1101348	-1.96	0.050	-.4316619 .0000586
SUP	-.0736163	.0844479	-0.87	0.383	-.2391312 .0918986
ACQ	-.263858	.0870212	-3.03	0.002	-.4344165 -.0932996
SPD	-.1879545	.3356303	-0.56	0.575	-.8457777 .4698688
_cons	.2298352	.3469357	0.66	0.508	-.4501462 .9098166

Marginal effects after logit

$$y = \text{Pr}(\text{PROMOTED}_{04}) \text{ (predict)}$$
$$= .76339161$$

vari able	dy/dx	Std. Err.	z	P> z	[95% C.I.]	X
COMAGE	-.00041877	.00279	-0.15	0.881	-.005884 .005046	24.2262
FEMALE*	-.0278774	.01794	-1.55	0.120	-.063048 .007293	.101737
SINGLE*	.0181009	.01506	1.20	0.229	-.011408 .04761	.151648
BLACK*	-.0415459	.02247	-1.85	0.064	-.085585 .002494	.062081
OTHERR-E*	-.0269745	.14217	-0.19	0.850	-.305615 .251666	.001231
LESSTH-0*	-.1135206	.17622	-0.64	0.519	-.458904 .231863	.000957
MASTER-E*	.1974641	.01148	17.20	0.000	.174962 .219966	.607275
DEP_2*	.0357693	.01425	2.51	0.012	.00784 .063699	.184056
DEP_3*	.0781609	.01317	5.94	0.000	.052353 .103969	.295364
DEP_4*	.1115877	.01327	8.41	0.000	.08558 .137596	.197457
ROTC_N-H*	.033792	.01498	2.26	0.024	.004424 .06316	.193628
ROTC_SCH*	-.0361519	.01336	-2.71	0.007	-.062332 -.009972	.307535
OTSAND-R*	.1163515	.01684	6.91	0.000	.083351 .149352	.229181
LOG*	-.0408119	.02174	-1.88	0.060	-.083417 .001794	.080268
SUP*	-.0134621	.01563	-0.86	0.389	-.044098 .011714	.178449
ACO*	-.0499478	.01719	-2.91	0.004	-.083635 -.016261	.148366
SPD*	-.0355821	.0664	-0.54	0.592	-.165729 .094565	.007658

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Figure 6. PROMOTED_O4 Logit Retention Model Results

Linear regression

Number of obs = 7313
 F(17, 7295) = 40.18
 Prob > F = 0.000
 R-squared = 0.0854
 Root MSE = .41919

PROMOTED_O4	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
COMAGE	-.0004226	.0025017	-0.17	0.866	-.0053268	.0044815
FEMALE	-.0251458	.0178543	-1.41	0.159	-.0601453	.0098538
SINGLE	.0193135	.0173994	1.11	0.267	-.0147943	.0534212
BLACK	-.0420708	.0221924	-1.90	0.058	-.0855743	.0014328
OTHERRACE	-.0278639	.1667719	-0.17	0.867	-.354785	.2990572
LESSTHANBD	-.1445536	.1974755	-0.73	0.464	-.5316627	.2425556
MASTERORAB-E	.1953066	.0110517	17.67	0.000	.173642	.2169712
DEP_2	.041719	.016547	2.52	0.012	.0092821	.0741559
DEP_3	.0852396	.0149541	5.70	0.000	.0559253	.1145539
DEP_4	.1219045	.0157889	7.72	0.000	.0909536	.1528554
ROTC_NON_SCH	.034827	.0150905	2.31	0.021	.0052452	.0644088
ROTC_SCH	-.0397921	.0140983	-2.82	0.005	-.0674289	-.0121553
OTSANDOTHER	.1087676	.0192275	5.66	0.000	.0710761	.1464591
LOG	-.036932	.018517	-1.99	0.046	-.0732308	-.0006333
SUP	-.0134259	.0137411	-0.98	0.329	-.0403624	.0135107
ACQ	-.0410195	.0146985	-2.79	0.005	-.0698327	-.0122062
SPD	-.0319338	.0534113	-0.60	0.550	-.1366354	.0727678
_cons	.5709352	.0572993	9.96	0.000	.458612	.6832585

Figure 7. PROMOTED_O4 Linear Probability Model Regression Results with Robust Standard Errors

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